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NSWC CRANE
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Final
Ground Water Monitoring Plan
for the
Ammunition Burning Grounds, Old Rifle Range, and Demolition Range

Naval Surface Warfare Center
Crane Division
Crane, Indiana

VOLUME II OF II - APPENDICES

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0038

September 1999

APPENDIX 1-1
COMPARISON OF RCRA APPENDIX VIII CONSTITUENTS TREATED OR EMITTED
AT ABG, ORR, OR DR
AND RCRA APPENDIX IX ANALYSES

COMPARISON OF RCRA A-VIII CONSTITUENTS TO CONSTITUENTS TREATED OR EMITTED AT ABG, ORR, OR DR, AND RCRA APPENDIX IX ANALYTES
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

HAZARDOUS CONSTITUENT	CAS	RCRA CODE	CONSITUENT OR EMISSION	UNIT	APPENDIX IX ANALYTE	
A2213	030558-43-1	U394	No		No	
Acetaldehyde	000075-07-0	U001	No		No	
Acetaldehyde, trichloro	000075-87-6	U034	No		No	
Acetamide, n-(4-ethoxyphenyl)-	000062-44-2	U187	No		No	
Acetamide, n-(aminothioxomethyl)-	000591-08-2	P002	No		No	
Acetamide, n-9h-fluoren-2-yl-,	000053-96-3	U005	No		No	
Acetic acid ethyl ester (I)	000141-78-6	U112	No		No	
Acetic acid, (2,4-dichlorophenoxy)-, salts & esters	000094-75-7	U240	No		No	
Acetic acid, fluoro, sodium salt	000062-74-8	P058	No		No	
Acetic acid, lead(2+)salt	000301-04-2	U144	No		No	
Acetic acid, thallium (1+)salt	000563-68-8	U214	No		No	
Acetone	000067-64-1	U002	No		Yes	
Acetonitrile	000075-05-8	U003	No		Yes	
Acetophenone	000098-86-2	U004	Yes	DR	Yes	
Acetyl chloride	000075-36-5	U006	No		No	
1-Acetyl-2-thiourea	000591-08-2	P002	No		No	
2-Acetylaminofluorene	000053-96-3	U005	No		Yes	
Acrolein	000107-02-8	P003	No		Yes	
Acrylamide	000079-06-1	U007	No		No	
Acrylic acid	000079-10-7	U008	No		No	
Acrylonitrile	000107-13-1	U009	No		Yes	
Aldicarb	000116-06-3	P070	No		No	
Aldicarb sulfone	001646-88-4	P203	No		No	
Aldrin	000309-00-2	P004	No		Yes	
Allyl alcohol	000107-18-6	P005	No		No	
Aluminum phosphide	020859-73-8	P006	No		No	
5-(Aminomethyl)-3-isoxazolol	002763-96-4	P007	No		No	
4-Aminopyridine	000504-24-5	P008	No		No	
Amitrole	000061-82-5	U011	No		No	
Ammonium picrate	000131-74-8	P009	No		No	
Ammonium vanadate	007803-55-6	P119	No		No	
Aniline	000062-53-3	U012	No		Yes	
Arsenic acid H3AsO4	007778-39-4	P010	No		Yes	(as Arsenic)
Arsenic pentoxide	001303-28-2	P011	No		Yes	(as Arsenic)
Arsenic trioxide production (as As)	001327-53-3	P012	No		Yes	(as Arsenic)
Arsinic aicd, dimethyl	000075-60-5	U136	No		No	
Auramine	000492-80-8	U014	No		No	
Azaserine	000115-02-6	U015	No		No	
Azirino[2',3':3,4]pyrrolo[1,2-a]indole-4,7-dione,6-amino-8-[[(aminocarbonyl)oxy]methyl]-1,1a,2,8,8a,8b-hexahydro-8a-methoxy-5-methyl-, [1as-(1a.alpha.,8.beta.,8a.alpha.,8b.alpha.)]-	000050-07-7	U010	No			
Barium cyanide	000542-62-1	P013	No		Yes	(as Barium)
Bendiocarb phenol	022961-82-6	U364	No		No	
Benomyl	017804-35-2	U271	No		No	
Benz(a)anthracene, 7,12-dimethyl-	000057-97-6	U094	No		Yes	
Benz[a]anthracene	000056-55-3	U018	Yes	ABG ORR DR	Yes	
Benz[c]acridine	000225-51-4	U016	No		No	
Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-	000050-49-5	U157	No		No	
Benzal chloride	000098-87-3	U017	No		No	
Benzamide, 3,5-dichloro-n-(1,1-diethyl-2-propynyl)-	023950-58-5	U192	No		No	
Benzenamine	000062-53-3	U012	No		No	
Benzene	000071-43-2	U019	Yes	ABG ORR DR	Yes	
Benzeneethanamine, alpha,alpha-dimethyl-	000122-09-8	P046	No		No	
Benzenesulfonyl chloride	000098-09-9	U020	No		No	
Benzenethiol	000108-98-5	P014	No		No	
Benzidine	000092-87-5	U021	No		No	
Benzo[a]pyrene	000050-32-8	U022	Yes	ABG ORR DR	Yes	
7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate	001563-66-2	P127	No		No	
Benzoic acid, 2-hydroxy-, compd. with (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5-yl-methylcarbamate ester (1:1)(Physostigmine salicylate)	000057-64-7	P188	No		No	
2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)- and salts when present at concentrations greater than 0.3%	000081-81-2	P001	No		No	
p-Benzoquinone	000106-51-4	U197	No		No	
Benzotrichloride	000098-07-7	U023	No		No	
Benzyl chloride	000100-44-7	P028	No		No	
Beryllium dust	007440-41-7	P015	No		Yes	(as Beryllium)
Beryllium powder	007440-41-7	P015	No		Yes	(as Beryllium)
2,2'-Bioxirane	001464-53-5	U085	No		No	
Bromoacetone	000598-31-2	P017	No		No	
Bromoform	000075-25-2	U225	No		Yes	
4-Bromophenyl phenyl ether	000101-55-3	U030	No		Yes	
Brucine	000357-57-3	P018	No		No	
2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[(methylamino)carbonyl] oxime	039196-18-4	P045	No		No	
Butyl alcohol, n-	000071-36-3	U031	No		No	
Cacodylic acid	000075-60-5	U136	No		No	

Calcium chromate (VI)	013765-19-0	U032	No	Yes	(as Chromium)
Calcium cyanide	000592-01-8	P021	No	Yes	(as Cyanide)
Camphechlor	008001-35-2	P123	No	No	
Carbamic acid, (3-chlorophenyl)-, 4-chloro-2-butynyl ester (Barban)	000101-27-9	U280	No	No	
Carbamic acid, 1H-benzimidazol-2-yl, methyl ester (Carbendizam)	010605-21-7	U372	No	No	
Carbamic acid, [1,2-phenylenebis(iminocarbonothioyl]bis-, dimethyl ester (Thiophanate-methyl)	023564-05-8	U409	No	No	
Carbamic acid, [1-[(butylamino)carbonyl]-1h-benzimidazol-2-yl]-, methyl ester (Benomyl)	017804-35-2	U271	No	No	
Carbamic acid, butyl-, 3-iodo-2-propynyl ester (3-1odo-2-propynyl n butylcarbamate)	055406-53-6	U375	No	No	
Carbamic acid, dimethyl-, 1-[(dimethyl-amino)carbonyl]-5 methyl-1H-pyrazol-3-yl ester (Dimetilan)	000644-64-4	P191	No	No	
Carbamic acid, dimethyl-3-methyl-1-(1-methylethyl)-1H-pyrazol-5-yl ester (Isolan)	000119-38-0	P192	No	No	
Carbamic acid, ethyl ester	000051-79-6	U238	No	No	
Carbamic acid, methyl-,3-methylphenyl ester (Metolcarb)	001129-41-5	P190	No	No	
Carbamic acid, methylnitroso-, ethyl ester	000615-53-2	U178	No	No	
Carbamic acid, phenyl, 1-methylethyl ester (Propham)	000122-42-9	U373	No	No	
Carbamic acid, [(dibutylamino)-thio]methyl-,2,3-dihydro-2,2-dimethyl-7-benzofuranyl ester	055285-14-8	P189	No	No	
Carbamic chloride, dimethyl-	000079-44-7	U097	No	No	
Carbamodithioic acid, (hydroxymethyl)-, monopotassium salt	051026-28-9	U378	No	No	
Carbamodithioic acid, 1,2-ethanediylbis, salts & esters	000111-54-6	U114	No	No	
Carbamodithioic acid, bis(1-methylethyl)-, S-(2,3,3-trichloro-2-propenyl)ester (Triallate)	002303-17-5	U389	No	No	
Carbamodithioic acid, butylethyl-, S-propyl ester (Pebulate)	001114-71-2	U391	No	No	
Carbamodithioic acid, dibutyl, sodium salt (Sodium dibutyldithiocarbamate)	000136-30-1	U379	No	No	
Carbamodithioic acid, diethyl, sodium salt (Sodium diethyl dibutylthiocarbamate)	000148-18-5	U381	No	No	
Carbamodithioic acid, diethyl-, 2-chloro-2-propenyl ester (Sulfallate)	000095-06-7	U277	No	No	
Carbamodithioic acid, dimethyl, potassium salt (Potassium dimethyl dithiocarbamate)	000128-03-0	U383	No	No	
Carbamodithioic acid, dimethyl- sodium salt (Sodium dimethyldithiocarbamate)	000128-04-1	U382	No	No	
Carbamodithioic acid, dimethyl-, tetraanhydroussulfide with orthothioselenious acid (Selenium tetrakis (dimethyldithiocarbamate))	000144-34-3	U376	No	No	
Carbamodithioic acid, methyl-, monopotassium salt (Potassium no-methyldithiocarbamate)	000137-41-7	U377	No	No	
Carbamodithioic acid, methyl-, monosodium salt (Metam sodium)	000137-42-8	U384	No	No	
Carbamothioic acid, bis(1-methylethyl)-,S-(2,3-dichloro-2-propenyl) ester	002303-16-4	U062	No	No	
Carbamothioic acid, bis(2-methylpropyl)-, S-ethyl ester	002008-41-5	U392	No	No	
Carbamothioic acid, cyclohexylethyl-, S-ethyl ester (Cycloate)	001134-23-2	U386	No	No	
Carbamothioic acid, dipropyl-, S-ethyl ester (EPTC)	000759-94-4	U390	No	No	
Carbamothioic acid, dipropyl-, S-phenylmethyl ester (Prosulfocarb)	052888-80-9	U387	No	No	
Carbamothioic acid, dipropyl-, S-propyl ester (Vernolate)	001929-77-7	U385	No	No	
Carbaryl	000063-25-2	U279	No	No	
Carbendazim	010605-21-7	U372	No	No	
Carbofuran	001563-66-2	P127	No	No	
Carbofuran phenol	001563-38-8	U367	No	No	
Carbon disulfide	000075-15-0	P022	No	Yes	
Carbon oxyfluoride	000353-50-4	U033	No	No	
Carbon tetrachloride	000056-23-5	U211	No	Yes	
Carbonic acid, dithallium (1+)salt	006533-73-9	U215	No	No	
Carbonic dichloride	000075-44-5	P095	No	No	
Carbonic difluoride	000353-50-4	U033	No	No	
Carbonochloridic acid, methyl ester	000079-22-1	U156	No	No	
Carbosulfan	055285-14-8	P189	No	No	
Chloral	000075-87-6	U034	No	No	
Chlorambucil	000305-03-3	U035	No	No	
Chlordane	000057-74-9	U036	No	Yes	
Chlornaphazine	000494-03-1	U026	No	No	
p-Chloro-m-cresol	000059-50-7	U039	No	No	
4-Chloro-o-toluidine hydrochloride	003165-93-3	U049	No	No	
Chloroacetaldehyde	000107-20-0	P023	No	No	
p-Chloroaniline	000106-47-8	P024	No	Yes	
Chlorobenzene	000108-90-7	U037	No	Yes	
Chlorobenzilate	000510-15-6	U038	No	Yes	
2-Chloroethyl vinyl ether	000110-75-8	U042	No	No	
Chloroform	000067-66-3	U044	No	Yes	
Chloromethyl methyl ether	000107-30-2	U046	No	No	
beta-Chloronaphthalene	000091-58-7	U047	No	Yes	

COMPARISON OF RCRA A-VIII CONSTITUENTS TO CONSTITUENTS TREATED OR EMITTED AT ABG, ORR, OR DR, AND RCRA APPENDIX IX ANALYTES
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

o-Chlorophenol	000095-57-8 U048	No		Yes	
1-(o-Chlorophenyl)thiourea	005344-82-1 P026	No		No	
3-Chloropropionitrile	000542-76-7 P027	No		No	
Chrysene	000218-01-9 U050	Yes	DR	Yes	
Copper cyanide	000544-92-3 P029	No		Yes	(as Copper and Cyanide)
Copper cyanide Cu(CN)	000544-92-3 P029	No		Yes	(as Copper and Cyanide)
Creosote	008001-58-9 U051	No		No	
m-Cresol	000108-39-4 U052	No		Yes	
Cresols	001319-77-3 U052	No		Yes	
Cresylic acid	001319-77-3	No		No	
Crotonaldehyde	004170-30-3 U053	No		No	
Cumene	000098-82-8 U055	No		No	
Cyanides (soluble salts and complexes) not otherwise specified	000057-12-5 P030	No		Yes	
Cyanogen	000460-19-5 P031	No		No	
Cyanogen bromide	000506-68-3 U246	No		No	
Cyanogen chloride	000506-77-4 P033	No		No	
Cyanogen chloride (CN)Cl	000506-77-4 P033	No		No	
Cyclohexane	000110-82-7 U056	No		No	
Cyclohexanone	000108-94-1 U057	No		No	
2-Cyclohexyl-4,6-Dinitrophenol	000131-89-5 P034	No		No	
Cyclophosphamide	000050-18-0 U058	No		No	
2,4-D salts & esters	000094-75-7 U240	No		Yes	
DDD (dichlorodiphenyldichloroethane)	000072-54-8 U060	No		Yes	
DDT	000050-29-3 U061	No		Yes	
Daunomycin	020830-81-3 U059	No		No	
Di-n-octyl phthalate	000117-84-0 U107	Yes	DR	Yes	
Di-n-propylnitrosamine	000621-64-7 U111	No			(n-Nitrosodi-n-propylamine)
Diallate	002303-16-4 U062	No		Yes	
Dibenz[a,h]anthracene	000053-70-3 U063	Yes	ABG ORR DR	Yes	
Dibenz[a,i]pyrene	000189-55-9 U064	No		No	
1,2-Dibromo-3-chloropropane (DBCP)	000096-12-8 U066	No		Yes	
Dibutyl phthalate	000084-74-2 U069	Yes	ABG ABG DR	Yes	
1,4-Dichloro-2-butene	000764-41-0 U074	No		No	
1,2-Dichlorobenzene	000095-50-1 U070	No		Yes	
m-Dichlorobenzene	000541-73-1 U071	No		Yes	
Dichlorobenzene, p-	000106-46-7 U072	Yes	DR	Yes	
3,3'-Dichlorobenzidene	000091-94-1 U073	No		Yes	
Dichlorodifluoromethane (CFC-12)	000075-71-8 U075	No		Yes	
Dichloroethyl ether	000111-44-4 U025	No		No	
1,2-Dichloroethylene	000156-60-5 U079	No		Yes	
1,1-Dichloroethylene or Refrigerant gas, R 1132a	000075-35-4 U078	No		Yes	
Dichloroisopropyl ether	000108-60-1 U027	No		No	
Dichloromethoxy ethane	000111-91-1 U024	No		No	
Dichloromethyl ether	000542-88-1 P016	No		No	
2,4-Dichlorophenol	000120-83-2 U081	No		Yes	
2,6-Dichlorophenol	000087-65-0 U082	No		Yes	
Dichlorophenylarsine	000696-28-6 P036	No		No	
1,2-Dichloropropane	000078-87-5 U083	No		Yes	
1,3-Dichloropropene	000542-75-6 U084	No		Yes	
Dieldrin	000060-57-1 P037	No		Yes	
O,O-Diethyl O-pyrazinyl phosphorothioate	000297-97-2 P040	No		No	
O,O-Diethyl S-methyl dithiophosphate	003288-58-2 U087	No		No	
Diethyl phthalate	000084-66-2 U088	Yes	ABG DR	Yes	
Diethyl-p-nitrophenyl phosphate	000311-45-5 P041	No		No	
Diethylarsine	000692-42-2 P038	No		No	
Diethylhexyl phthalate	000117-81-7 U028	Yes	DR	Yes	
N,N'-Diethylhydrazine	001615-80-1 U086	No		No	
Diethylstilbesterol (DES)	000056-53-1 U089	No		No	
Dihydrosafrole	000094-58-6 U090	No		No	
Diisopropylfluorophosphate	000055-91-4 P043	No		No	
Diisopropylfluorophosphate (DFP)	000055-91-4 P043	No		No	
2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1a.alpha.,2.beta.,2a.alpha.,3.beta.,6.beta.,6a.alph.,7.beta.,7a.alpha.)-	000060-57-1 P037	No		No	
2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1a.alpha.,2.beta.,2a.beta.,3.alpha.,6.alpha.,6a.bet.,7.beta.,7a.alpha.)-	000072-20-8 P051	No		No	
1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-, (1.alpha.,4.alpha.,4a.beta.,5.alpha.,8.alpha.,8a.beta.)-	000309-00-2 P004	No		No	
1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-, (1.alpha.,4.alpha.,4a.beta.,5.alpha.,8.alpha.,8a.beta.)-	000465-73-6 P060	No		No	
Dimethoate	000060-51-5 P044	No		Yes	
3,3'-Dimethoxybenzidine (ortho-Dianisidine)	000119-90-4 U091	No		No	
Dimethyl phthalate	000131-11-3 U102	Yes	DR	Yes	
Dimethyl sulfate	000077-78-1 U103	No		No	

Dimethylamine	000124-40-3	U092	No		No	
para-Dimethylaminoazobenzene	000060-11-7	U093	No		Yes	
p-Dimethylaminoazobenzene	000060-11-7	U093	No		Yes	
7,12-Dimethylbenz[a]anthracene	000057-97-6	U094	No		Yes	
3,3'-Dimethylbenzidine (o-Tolidine)	000119-93-7	U095	No		Yes	
alpha,alpha-Dimethylbenzylhydroperoxide	000080-15-9	U096	No		No	
Dimethylcarbamyl chloride	000079-44-7	U097	No		No	
1,1-Dimethylhydrazine	000057-14-7	U098	No		No	
1,2-Dimethylhydrazine	000540-73-8	U099	No		No	
alpha,alpha-dimethylphenethylamine	000122-09-8	P046	Yes	DR	Yes	
2,4-Dimethylphenol	000105-67-9	U101	No		Yes	
Dimetilan	000644-64-4	P191	No		No	
4,6-Dinitro-o-cresol	000534-52-1	P047	No		Yes	
2,4-Dinitrophenol	000051-28-5	P048	No		Yes	
2,4-Dinitrotoluene	000121-14-2	U105	Yes	ABG DR	Yes	
2,6-Dinitrotoluene	000606-20-2	U106	Yes	ABG DR	Yes	
Dinoseb	000088-85-7	P020	No		Yes	
1,4-Dioxane	000123-91-1	U108	No		No	
1,2-Diphenylhydrazine (Hydrazobenzene)	000122-66-7	U109	No		No	
Diphosphoramide, octamethyl-	000152-16-9	P085	No		No	
Diphosphoric acid, tetraethyl ester	000107-49-3	P111	No		No	
Dipropylamine	000142-84-7	U110	No		No	
Disulfoton	000298-04-4	P039	No		No	
Dithiobiuret	000541-53-7	P049	No		No	
1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O-[(methylamino)-carbonyl]oxime (Tirpate)	026419-73-8	P185	No		No	
Endosulfan	000115-29-7	P050	No		Yes	
Endothall	000145-73-3	P088	No		No	
Endrin	000072-20-8	P051	No		Yes	
Endrin and metabolites	000072-20-8	P051	No		Yes	
Epichlorohydrin	000106-89-8	U041	No		No	
Epinephrine	000051-43-4	P042	No		No	
Ethanedinitrile	000460-19-5	P031	No		No	
Ethanimidothioic acid, 2-(dimethylamino)-N-[[(methylamino)carbonyl]oxy]-2-oxo-, methyl ester (Oxamyl)	023135-22-0	P194	No		No	
Ethanimidothioic acid, n-[[(methylamino)carbonyl]oxy]-, methyl ester	016752-77-5	P066	No		No	
Ethyl acetate	000141-78-6	U112	No		No	
Ethyl acrylate	000140-88-5	U113	No		No	
Ethyl carbamate (urethane)	000051-79-6	U238	No		No	
Ethyl cyanide	000107-12-0	P101	No		Yes	(as Cyanide)
Ethyl ether	000060-29-7	U117	No		No	
Ethyl methacrylate	000097-63-2	U118	No		Yes	
Ethyl methanesulfonate	000062-50-0	U119	No		Yes	
n-Ethyl-N-nitrosourea	000759-73-9	U176	No		No	
Ethylene dibromide	000106-93-4	U067	No		No	
Ethylene dichloride	000107-06-2	U077	No		No	
Ethylene glycol monoethyl ether	000110-80-5	U359	No		No	
Ethylene oxide	000075-21-8	U115	No		No	
Ethylene thiourea	000096-45-7	U116	No		No	
Ethylenebisdithiocarbamic acid, salts & esters (EBDCs)	000111-54-6	U114	No		No	
Ethyleneimine, inhibited	000151-56-4	P054	No		No	
Ethylidene dichloride	000075-34-3	U076	No		No	
Famphur	000052-85-7	P097	No		Yes	
Fluoranthene	000206-44-0	U120	Yes	DR	Yes	
Fluorine	007782-41-4	P056	No		No	
Fluoroacetamide	000640-19-7	P057	No		No	
Fluoroacetic acid, sodium salt	000062-74-8	P058	No		No	
Formaldehyde	000050-00-0	U122	No		No	
Formetanate hydrochloride	023422-53-9	P198	No		No	
Formic acid	000064-18-6	U123	No		No	
Formparanate	017702-57-7	P197	No		No	
Fulminic acid, mercury (2+)salt	000628-86-4	P065	No		No	
Furan	000110-00-9	U124	No		Yes	
Furfural	000098-01-1	U125	No		No	
Glycidylaldehyde	000765-34-4	U126	No		No	
Heptachlor	000076-44-8	P059	No		Yes	
Hexachloro-1,3-butadiene	000087-68-3	U128	No		Yes	
Hexachlorobenzene	000118-74-1	U127	No		Yes	
Hexachlorocyclopentadiene	000077-47-4	U130	No		Yes	
Hexachloroethane	000067-72-1	U131	No		Yes	
Hexachlorophene	000070-30-4	U132	No		No	
Hexachloropropene	001888-71-7	U243	No		Yes	
Hexaethyl tetraphosphate	000757-58-4	P062	No		No	
Hydrazine (anhydrous)	000302-01-2	U133	No		No	
Hydrazinecarbothioamide	000079-19-6	P116	No		No	
Hydrocyanic acid	000074-90-8	P063	Yes	ABG ORR DR	Yes	(as Cyanide)
Hydrofluoric acid	007664-39-3	U134	No		No	
Hydrogen cyanide	000074-90-8	P063	Yes	ABG ORR DR	Yes	(as Cyanide)

Hydrogen phosphide	007803-51-2	P096	No		No	
Hydrogen sulfide	007783-06-4	U135	No		No	
Indeno[1,2,3-cd]pyrene	000193-39-5	U137	No		Yes	
Isobutyl alcohol	000078-83-1	U140	No		Yes	
Isodrin	000465-73-6	P060	No		Yes	
Isolan	000119-38-0	P192	No		No	
3-Isopropylphenyl N-methylcarbamate	000064-00-6	P202	No		No	
Isosafrole	000120-58-1	U141	No		Yes	
3(2H)-Isoxazolone, 5-(aminomethyl)-	002763-96-4	P007	No		No	
Kepone	000143-50-0	U142	No		Yes	
Lasiocarpine	000303-34-4	U143	No		No	
Lead acetate	000301-04-2	U144	No		Yes	(as Lead)
Lead phosphate	007446-27-7	U145	No		Yes	(as Lead)
Lead subacetate	001335-32-6	U146	No		Yes	(as Lead)
Lindane	000058-89-9	U129	No		No	
MNNG	000070-25-7	U163	No		No	
Maleic anhydride	000108-31-6	U147	No		No	
Maleic hydrazide	000123-33-1	U148	No		No	
Malononitrile	000109-77-3	U149	No		No	
Manganese dimethyldithiocarbamate	015339-36-2	P196	No		No	
Manganese, bis(dimethylcarbamodithioato-S,S')-	015339-36-3	P196	No		No	
Mercury	007439-97-6	U151	No		Yes	
Mercury fulminate (R, T)	000628-86-4	P065	No		No	
Mercury, (acetato-o)phenyl-	000062-38-4	P092	No		No	
Methacrylonitrile	000126-98-7	U152	No		Yes	
Methane, isocyanato-	000624-83-9	P064	No		No	
Methane, oxybis[chloro-	000542-88-1	P016	No		No	
Methane, tetranitro- (R)	000509-88-1	P112	No		No	
Methanethiol, trichloro-	000075-70-7	P118	No		No	
Methanimidamide, N,N-dimethyl-N'-[3-[[(methylamino)-carbonyl]oxy]phenyl]-,monohydrochloride (Formanate hydrochloride)	023422-53-9	P198	No		No	
Methanimidamide, N,N-dimethyl-N'-(2-methyl-4-[[(methylamino)carbonyl]oxy]phenyl]- (Formparanate)	017702-57-7	P197	No		No	
4,7-Methano-1h-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-	000076-44-8	P059	No		No	
6,9-Methano-2,4,3-benzodioxathiepin, 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide	000115-29-7	P050	No		No	
Methapyrilene	000091-80-5	U155	No		Yes	
Methiocarb	002032-65-7	P199	No		No	
Methomyl	016752-77-5	P066	No		No	
Methoxychlor	000072-43-5	U247	No		Yes	
Methyl bromide	000074-83-9	U029	No		No	
Methyl chloride or Refrigerant gas R40	000074-87-3	U045	No		No	
Methyl chlorocarbonate	000079-22-1	U156	No		No	
Methyl chloroform	000071-55-6	U226	No		Yes	
Methyl ethyl ketone (MEK)	000078-93-3	U159	No		Yes	
Methyl ethyl ketone peroxide	001338-23-4	U160	No		No	
Methyl hydrazine	000060-34-4	P068	No		No	
Methyl iodide	000074-88-4	U138	No		Yes	
Methyl isobutyl ketone	000108-10-1	U161	No		Yes	
Methyl isocyanate	000624-83-9	P064	No		No	
Methyl methacrylate	000080-62-6	U162	No		Yes	
Methyl parathion	000298-00-0	P071	No		Yes	
n-Methyl-N-nitrosourea	000684-93-5	U177	No		No	
3-Methylcholanthrene	000056-49-5	U157	No		Yes	
Methylene bromide	000074-95-3	U068	No		No	
Methylene chloride	000075-09-2	U080	No		Yes	
4,4'-Methylenebis(2-chloroaniline)	000101-14-4	U158	No		No	
2-Methyllactonitrile	000075-86-5	P069	No		No	
Methylthiouracil	000056-04-2	U164	No		No	
Metolcarb	001129-41-5	P190	No		No	
Mexacarbate	000315-18-4	P128	No		No	
Mitomycin C	000050-07-7	U010	No		No	
Naphthalene	000091-20-3	U165	Yes	ABG ORR DR	Yes	
1,4-Naphthoquinone	000130-15-4	U166	No		Yes	
alpha-Naphthylamine	000134-32-7	U167	No		Yes	
beta-Naphthylamine	000091-59-8	U168	Yes	ABG ORR	Yes	
alpha-Naphthylthiourea	000086-88-4	P072	No		No	
Nickel carbonyl (as Ni)	013463-39-3	P073	No		Yes	
Nickel carbonyl Ni(CO)(4), (T-4)-	013463-39-3	P073	No		Yes	
Nickel cyanide	000557-19-7	P074	No		Yes	(as Nickel and Cyanide)
Nickel cyanide Ni(CN)(2)	000557-19-7	P074	No		Yes	(as Nickel and Cyanide)
Nicotine, & salts	--	P075	No		No	
Nitric oxide	010102-43-9	P076	Yes	ABG ORR DR	No	
5-Nitro-o-toluidine	000099-55-8	U181	No		Yes	
p-Nitroaniline	000100-01-6	P077	No		Yes	
Nitrobenzene	000098-95-3	U169	No		Yes	
Nitrogen dioxide	010102-44-0	P078	Yes	ABG ORR DR	No	

Nitrogen oxide NO	010102-43-9	P076	Yes	ABG ORR DR	No	
Nitrogen oxide NO(2)	010102-44-0	P078	Yes	ABG ORR DR	No	
Nitroglycerin	000055-63-0	P081	Yes	ABG DR	Yes	
4-Nitrophenol	000100-02-7	U170	Yes	DR	Yes	
p-Nitrophenol	000100-02-7	U170	Yes	DR	Yes	
2-Nitropropane	000079-46-9	U171	No		No	
n-Nitroso-N-methylurethane	000615-53-2	U178	No		No	
n-Nitrosodi-n-butylamine	000924-16-3	U172	No		Yes	
n-Nitrosodiethanolamine	001116-54-7	U173	No		No	
n-Nitrosodiethylamine	000055-18-5	U174	Yes	DR	Yes	
n-Nitrosodimethylamine	000062-75-9	P082	No		Yes	
n-Nitrosomethylvinylamine	004549-40-0	P084	No		No	
n-Nitrosopiperidine	000100-75-4	U179	No		Yes	
n-Nitrosopyrrolidine	000930-55-2	U180	No		Yes	
Octamethylpyrophosphoramide	000152-16-9	P085	No		No	
Osmium oxide OsO(4), (T-4)-	020816-12-0	P087	No		No	
Osmium tetroxide	020816-12-0	P087	No		No	
7-Oxabicyclo(2,2,1)heptane-2,3-dicarboxylic acid,	000145-73-3	P088	No		No	
Oxamyl	023135-22-0	P194	No		No	
Paraldehyde	000123-63-7	U182	No		No	
Parathion	000056-38-2	P089	No		No	
Pentachlorobenzene	000608-93-5	U183	No		Yes	
Pentachloroethane	000076-01-7	U184	No		Yes	
Pentachloronitrobenzene	000082-68-8	U185	No		Yes	
Pentachlorophenol	000087-86-5	See F027	No		Yes	
1,3-Pentadiene	000504-60-9	U186	No		No	
Phenacetin	000062-44-2	U187	No		Yes	
Phenol	000108-95-2	U188	Yes	ABG ORR DR	Yes	
Phenol, 2,4,6-trinitro-, ammonium salt	000131-74-8	P009	No		No	
Phenol, 2,4-dinitro	000051-28-5	P048	No		Yes	
Phenol, 2-(1-methylpropyl)-4,6-dinitro	000088-85-7	P020	No		No	
Phenol, 2-cyclohexyl-4,6-dinitro-	000131-89-5	P034	No		No	
Phenol, 2-methyl-4,6-dinitro- and salts	000534-52-1	P047	No		No	
Phenol, 3,5-dimethyl-4-(methylthio)-, methylcarbamate	002032-65-7	P199	No		No	
Phenol, 3-(1-methylethyl)-, methylcarbamate	000064-00-6	P202	No		No	
Phenol, 4-(dimethylamino)-3,5-dimethyl-, methylcarbamate (ester)	000315-18-4	P128	No		No	
Phenol,3-methyl-5-(1-methylethyl)-methyl carbamate	002631-37-0	P201	No		No	
Phenylmercuric acetate (dry)	000062-38-4	P092	No		No	
Phenylthiourea	000103-85-5	P093	No		No	
Phorate	000298-02-2	P094	No		Yes	
Phosgene	000075-44-5	P095	No		No	
Phosphine	007803-51-2	P096	No		No	
Phosphonic acid, diethyl-4-nitrophenyl ester	000311-45-5	P041	No		No	
Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)ethyl]ester	000298-04-4	P039	No		No	
Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl]ester	000298-02-2	P094	No		No	
Phosphorodithioic acid, O,O-dimethyl O-(4-nitropheyl)ester	000296-00-0	P071	No		No	
Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl]ester	000060-51-5	P044	No		No	
Phosphorodithioic acid, O-O,4[(dimethylamino)sulfonyl)phenyl]O,O-dimethyl ester	000052-85-7	P097	No		No	
Phosphorofluoridic acid, bis-(1-methylethyl)ester	000055-91-4	P043	No		No	
Phosphorothoic acid, O,O-diethyl O-(-4-nitropheyl) ester	000056-38-2	P089	No		No	
Phosphorothoic acid, O,O-diethyl O-pyrazinyl ester	000297-92-2	P040	No		No	
Phthalic anhydride with more than .05% maleic anhydride	000085-44-9	U190	No		No	
Physostigmine	000057-47-6	P204	No		No	
Physostigmine, salicylate (1:1)	000057-64-7	P188	No		No	
2-Picoline	000109-06-8	U191	No		Yes	
Plumbane, tetraethyl-	000078-00-2	P110	No		Yes	(as Lead)
Potassium cyanide	000151-50-8	P098	No		Yes	(as Cyanide)
Potassium cyanide K(CN)	000151-50-8	P098	No		Yes	(as Cyanide)
Potassium silver cyanide	000506-61-6	P099	No		Yes	(as Cyanide)
Promecarb	002631-37-0	P201	No		No	
Pronamide	023950-58-5	U192	No		Yes	
Propanal, 2-methyl-2-(methylthio)-, o-[(methylamino)carbonyl]oxime	000116-06-3	P070	No		No	
1,3-Propane sultone	001120-71-4	U193	No		No	
Propanenitrile	000107-12-0	P101	No		Yes	
Propanenitrile, 2-hydroxy-2-methyl-	000075-86-5	P069	No		No	
Propanenitrile, 3-chloro-	000542-76-7	P027	No		No	
1,2,3-Propanetriol, trinitrate (R)	000055-63-0	P081	No		No	
2-Propanone, 1-bromo-	000598-31-2	P017	No		No	
Propargyl alcohol	000107-19-7	P102	No		No	
2-Propen-1-ol	000107-18-6	P005	No		No	
2-Propenal	000107-02-8	P003	No		No	
Proponal, 2-methyl-2-(methyl-sulfonyl)-,O-[(methylamino)carbonyl]oxime	001646-88-4	P203	No		No	
n-Propylamine	000107-10-8	U194	No		No	
Propylene dichloride	000078-87-5	U083	No		No	

COMPARISON OF RCRA A-VIII CONSTITUENTS TO CONSTITUENTS TREATED OR EMITTED AT ABG, ORR, OR DR, AND RCRA APPENDIX IX ANALYTES
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

1,2-Propylenimine	000075-55-8	P067	No		No	
2-Propyn-1-ol	000107-19-7	P102	No		No	
4-Pyridinamine	000504-24-5	P008	No		No	
Pyridine	000110-86-1	U196	No		Yes	
Pyridine, 3-(1-methyl-2-pyrrolidinyl)-,(S)-and salts	000054-11-5	P075	No		No	
Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-, methylcarbamate (ester), (3aS-cis)- (Physostigmine	000057-47-6	P204	No		No	
Reserpine	000050-55-5	U200	No		No	
Resorcinol	000108-46-3	U201	No		No	
Saccharin, & salts	000081-07-2	U202	No		No	
Safrole	000094-59-7	U203	No		Yes	
Selenious acid	007783-00-8	U204	No		No	
Selenious acid, dithallium(1+) salt	012039-52-0	P114	No		No	
Selenium sulfide	007488-56-4	U205	No		No	
Selenourea	000630-10-4	P103	No		No	
Silver cyanide	000506-64-9	P104	No		Yes	(as Silver and Cyanide)
Silver cyanide Ag(CN)	000506-64-9	P104	No		Yes	(as Silver and Cyanide)
Silvex (2,4,5-tp)	000093-72-1	See F027	No		Yes	
Sodium azide	026628-22-8	P105	No		No	
Sodium cyanide	000143-33-9	P106	No		Yes	(as Cyanide)
Sodium cyanide (Na(CN))	000143-33-9	P106	No		Yes	(as Cyanide)
Streptozotocin	018883-66-4	U206	No		No	
Strychnidin-10-one, 2,3-dimethoxy-	000357-57-3	P018	No		No	
Strychnidin-10-one, and salts	000057-24-9	P108	No		No	
Strychnine, & salts	000057-24-9	P108	No		No	
Sulfur phosphide	001314-80-3	U189	No		No	
Sulfuric acid, dithallium(1+) salt	007446-18-6	P115	No		No	
2,4,5-T	000093-76-5	See F027	No		Yes	
1,2,4,5-Tetrachlorobenzene	000095-94-3	U207	No		Yes	
1,1,1,2-Tetrachloroethane	000630-20-6	U208	No		Yes	
1,1,2,2-Tetrachloroethane	000079-34-5	U209	No		Yes	
Tetrachloroethylene	000127-18-4	U210	No		Yes	
2,3,4,6-Tetrachlorophenol	000058-90-2	See F027	No		Yes	
Tetraethyl lead	000078-00-2	P110	No		No	
Tetraethyl pyrophosphate	000107-49-3	P111	No		No	
Tetraethyldithiopyrophosphate	003689-24-5	P109	No		Yes	
Tetrahydrofuran	000109-99-9	U213	No		No	
Tetranitromethane	000509-14-8	P112	No		No	
Tetraphosphoric acid, hexaethyl ester	000757-58-4	P062	No		No	
Thallic oxide	001314-32-5	P113	No		No	
Thallium (I) acetate	000563-68-8	U214	No		No	
Thallium (I) carbonate	006533-73-9	U215	No		No	
Thallium (I) nitrate	010102-45-1	U217	No		No	
Thallium (I) sulfate	007446-18-6	P115	No		No	
Thallium chloride TICl	007791-12-0	U216	No		No	
Thallium oxide Tl(2)O(3)	001314-32-5	P113	No		No	
Thallium sulfate	012039-52-0	P114	No		No	
Thioacetamide	000062-55-5	U218	No		No	
Thiodiphosphoric acid, tetraethyl ester	003689-24-5	P109	No		No	
Thiofanox	039196-18-4	P045	No		No	
Thiomethanol	000074-93-1	U153	No		No	
Thiomidodicarbamic diamide [(H(2)N)C(S)](2)NH	000541-53-7	P049	No		No	
Thiophenol	000108-98-5	P014	No		No	
Thiosemicarbazide	000079-19-6	P116	No		No	
Thiourea	000062-56-6	U219	No		No	
Thiourea, (2-chlorophenyl)-	005344-82-1	P026	No		No	
Thiourea, 1-naphthalenyl-	000086-88-4	P072	No		No	
Thiourea, phenyl-	000103-85-5	P093	No		No	
Thiram	000137-26-8	U244	No		No	
Tirpate	026419-73-8	P185	No		No	
Toluene	000108-88-3	U220	Yes	DR	Yes	
Toluene diisocyanate	026471-62-5	U223	No		No	
o-Toluidine hydrochloride	000636-21-5	U222	No		No	
o-Toluidine	000095-53-4	U328	No		Yes	
p-Toluidine	000106-49-0	U353	No		No	
Toxaphene	008001-35-2	P123	No		Yes	
1,1,2-Trichloroethane	000079-00-5	U227	No		Yes	
Trichloroethylene	000079-01-6	U228	No		Yes	
Trichloromethanethiol	000075-70-7	P118	No		No	
Trichloromonofluoromethane (CFC-11)	000075-69-4	U121	No		Yes	
2,4,5-Trichlorophenol	000095-95-4	See F027	No		Yes	
2,4,6-Trichlorophenol	000088-06-2	See F027	No		Yes	
1,3,5-Trinitrobenzene	000099-35-4	U234	Yes	ABG ORR DR	Yes	
Tris(2,3-dibromopropyl)phosphate	000126-72-7	U235	No		No	
Trypan blue	000072-57-1	U236	No		No	
Uracil mustard	000066-75-1	U237	No		No	
Vanadic acid, ammonium salt	007803-55-6	P119	No		Yes	(as Vanadium)
Vanadium oxide V(2)O(5)	001314-62-1	P120	No		Yes	(as Vanadium)
Vanadium pentoxide	001314-62-1	P120	No		Yes	(as Vanadium)

Vinyl chloride	000075-01-4	U043	No		Yes	
Vinylamine, N-methyl-N-nitroso	004549-40-0	P084	No		No	
Warfarin, & salts, when present at concentrations <= 0.3%	000081-81-2	U248	No		No	
Warfarin, & salts, when present at concentrations > 0.3%	000081-81-2	P001	No		No	
Xylene (mixed isomers)	001330-20-7	U239	Yes	DR	Yes	
m-Xylene	000108-38-3	U239	Yes	DR	Yes	
Zinc cyanide	000557-21-1	P121	No		Yes	(as Zinc and Cyanide)
Zinc cyanide Zn(CN)(2)	000557-21-1	P121	No		Yes	(as Zinc and Cyanide)
Zinc phosphide Zn(3)P(2), when present at concentrations > 10% (R,T)	001314-84-7	P122	No		Yes	(as Zinc)
Zinc, bis(dimethylcarbamodithioato-S,S')-,	000137-30-4	P205	No		Yes	(as Zinc)
Ziram	000137-30-4	P205	No		No	

APPENDIX 2-1

ENVIRONMENTAL DATA ASSESSMENT MEMORANDUM

FOR

SOLID WASTE MANAGEMENT UNITS #03/10, #06/09, AND #07/09

NAVAL SURFACE WARFARE CENTER

CRANE DIVISION

CRANE, INDIANA

Environmental Data Assessment Memorandum

for

Solid Waste Management Units #03/10, #06/09, and #07/09

Naval Surface Warfare Center, Crane Division

Crane, Indiana

Northern Division

Naval Facilities Engineering Command

Contract No. GCPP-91-001-1298

Contract Task Order 0229

July 1997

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TECHNICAL MEMORANDUM

1.0 INTRODUCTION

1.1 BACKGROUND/PURPOSE OF THIS MEMORANDUM

In 1992, Rust Environment & Infrastructure (Brown & Root Environmental Team) was tasked by Halliburton NUS under a Comprehensive Long-term Environmental Action Navy (CLEAN) Prime Contract with the Naval Facilities Engineering Command to conduct a Human Health and Environmental Risk Assessment on three Solid Waste Management Units (SWMUs) at the Naval Surface Warfare Center, Crane Division, Crane, Indiana (NAVSURFWARCENDIV). The three SWMUs are #03/10 (ABG; Ammunition Burning Ground, including the "Jeep Trail Area"), #07/09 (ORR; Old Rifle Range), and #06/09 (DR; Demolition Range). Waste explosive open burning activities occur at the first two SWMUs, while detonation activities occur at the Demolition Range. The risk assessment is intended to estimate the potential human health and ecological impacts of ABG, ORR, and DR to satisfy the requirements of both 40 CFR Part 264 Subpart X and the notice of deficiency issues that have been identified in NAVSURFWARCENDIV's RCRA Part B permit application.

In preparation for this risk assessment, a detailed risk assessment work plan (RAWP) was developed by the Halliburton NUS team in July 1995 (HNUS, 1995). The primary objectives of this RAWP were: (1) to develop site conceptual models for each SWMU, (2) to review and summarize the existing site data for each SWMU, and (3) to prepare a Sampling and Analysis Plan (SAP) that describes any supplemental data that would need to be collected at each SWMU for completion of the risk assessment.

The SAP was developed by Brown & Root Environmental Team and submitted along with the RAWP. After acceptance of the RAWP and the SAP, Brown & Root Environmental Team performed the necessary supplemental field work at the facility during 1995/6. The SAP was based on the existing RFI data at each SWMU, which originated from a variety of sources and regulatory programs. For example, the U.S. Army Corps of Engineer laboratory (WES) conducted a multi-phase Release Characterization Study at ABG (Murphy, 1992a), which entailed the identification of the nature and extent of hazardous constituents in soil at this SWMU. WES also conducted two other multi-phase Groundwater Release Characterization Studies at ABG that addressed contamination in surface water, sediment and groundwater (Murphy, 1992b; Murphy

and Wade, 1994a). As part of the risk assessment task, Brown & Root Environmental Team supplemented these existing databases with additional analytical data. These latter data were obtained using Southwest Laboratories. Historical groundwater data for ABG (pre-1990) were obtained using three other laboratories - Enseco (now called Quanterra), Anacon, and Synergic Analytics. Similar situations exist for ORR and DR.

One of the first tasks following the acceptance of the RAWP was the conductance of a trend analysis of the groundwater data obtained at each SWMU. The purpose of this trend analysis was to determine the methodology to be used to calculate the groundwater exposure point concentrations in the risk assessment. A trend analysis was completed by Brown & Root Environmental Team and submitted to the USEPA in 1996 (Brown & Root Environmental Team, 1996).

During the preparation of this trend analysis an issue of data validation of the facility's historical analytical data was raised. It was discovered that very little of the analytical data collected at these SWMUs in the past (pre - 1995) had undergone a data validation effort of sufficient rigor to produce results that met the minimum data useability standards for risk assessment purposes. This issue was brought to the attention of USEPA, whereupon a relatively detailed review of select data sets from each laboratory was performed by USEPA and their contractor (A.T. Kearney) (USEPA, 1997).

After the data review was completed, USEPA informed the Halliburton NUS team that not all of the historical data for these sites were acceptable for use in the risk assessment. Specifically, USEPA's recommendations were:

<u>Non-Explosives Target Parameters</u>

- Southwest Laboratory - VOC, SVOC, and metals data (with the exception of tin, which was not reported) should be considered useable for risk assessment purposes.
- Enseco Laboratory - nonexplosives data are recommended for use in assessing site risks.
- Anacon Laboratory - none of these data may be utilized for purposes of the human health risk assessment study.
- Synergic Analytics - it is not recommended that these data be utilized in a risk assessment study.

- WES (U.S. Army Corps of Engineers) Laboratory - these data shall be rejected from further risk assessment considerations due to a lack of QC documentation.

Explosives Target Parameters

- Anacon Laboratory - these data must be rejected.
- Synergic Analytics - these data must be rejected.
- WES (U.S. Army Corps of Engineers) Laboratory - data for only certain parameters will be considered (1990 - HMX, RDX, TNB, 1,3-DNB, Tetryl, TNT, 2,4-DNT, 2,6-DNT; 1993 - HMX, RDX, TNB, 1,3-DNB, Tetryl, TNT, 2,4-DNT, 2,6-DNT, 2-amino-DNT, 4-amino-DNT).
- Southwest Laboratory - these data are acceptable for use in defining human health risks.
- Enseco Laboratory - these data are acceptable for use in defining human health risks.

Consequent to this rejection of some of the analytical data available for these three SWMUs and because the original Brown & Root Environmental Team RAWP was developed assuming that all of these data would be useable, a reanalysis of the 'revised' analytical databases for these SWMUs must again be completed.

The purposes of this memorandum therefore are: (1) to recreate the databases detailing the currently acceptable (i.e. valid) data for each environmental medium at each of these three SWMUs in light of this latest QC review, and (2) to determine if significant data gaps exist. If datagaps are found to be present, specific recommendations are to be made to resolve the issue.

1.2 ORGANIZATION OF THIS MEMORANDUM

Following this introductory section, this memorandum has been organized to provide the reader with an initial brief background history of the activities at each of these SWMUs (Section 2.0) and the general environmental setting of the facility (Section 3.0). Then, a discussion on a SWMU-specific and environmental medium-specific basis is provided that documents any impacts that the rejected analytical data may have on the risk assessment (Section 4.0). The text of this memorandum concludes with Brown & Root Environmental Team's

recommendations as to the preferred technical disposition of any significant 'data gaps' (Section 5.0). Section 6.0 lists all of the published references cited in this memorandum.

2.0 SITE BACKGROUND/HISTORY

2.1 INTRODUCTION

In 1940, Congress authorized construction of a Naval Ammunition Depot (NAD) in southern Indiana (Figure 2-1). In late 1941, the Burns City Naval Ammunition Depot was commissioned. In 1943, NAD Burns City was renamed NAD Crane. NAD Crane's overall mission was to load, prepare, renovate, receive, store, and issue ammunition to the fleet.

During World War II, NAD Crane's mission expanded to include pyrotechnics production, mine filling, rocket assembly, field storage, torpedo storage, and ordnance spare parts and mobile equipment storage. During the 1950s, several new departments were created, the Ammunition Loading and Production Engineering Center (ALPEC) was transferred to Crane, and the Central Ammunition Supply Control Office (CASCO) was established. NAD Crane supplied ammunition to the fleet during the Korean and Vietnam conflicts.

In 1976, NAD Crane was designated Naval Weapons Support Center Crane (NWSCC). Its new mission was to provide support for ships and crafts equipment, shipboard weapons' systems and assigned ordnance items, and to perform additional functions as directed. Most recently in 1992, NWSCC was designated NAVSURFWARCENDIV.

Operations within the Ammunitions Burning Ground (ABG) and the Old Rifle Range (ORR) at NAVSURFWARCENDIV can be generalized as open burning of waste explosive and explosive-contaminated materials; operations within the Demolition Range (DR) can be characterized as ordnance detonation.

2.2 AMMUNITION BURNING GROUND (SWMU #03/10)

The Ammunition Burning Ground (ABG) covers approximately 20 acres in a remote area near the east center boundary of the facility in the valley of Little Sulphur Creek (Figure 2-2; Murphy, 1992a).

Ordnance and ordnance-contaminated materials from NAVSURFWARCENDIV production areas have been taken to the ABG for disposal by burning since the 1940s. The burning ground is used extensively for destroying unwanted materials contaminated with explosives, bare explosives, rocket motors, candles, flares, solvents, detonators, and fuse materials. Several separate burning areas are within the site. The largest

quantities of materials were destroyed from 1956 to 1960, when 15,000 pounds per day of smokeless powder were destroyed. In the same period, about 46,000 lbs per day of high explosives were burned. The area is also used for flashing the residue from bombs and projectiles after they have been subjected to melt-out or drill-out operations for removal of the bulk of the explosive (Murphy, 1992a). Powder flashing and bomb burn-out were also conducted at an area called "Jeep Trail Area", which is approximately one-half mile southeast of the ABG between Little Sulphur Creek and Jeep Trail 25.

2.3 DEMOLITION RANGE (SWMU #06/09)

The Demolition Range (DR) covers an area of 40 to 50 acres (A.T. Kearney, Inc., 1987) and lies on two steep-sided ridgetops (Figure 2-2). The east ridge is used by the U.S. Navy Explosive Ordnance Disposal (EOD) Detachment to detonate ordnance with an explosive limit of 500 pounds per detonation (Naval EOD, 1993). The south ridge is used by the U.S. Army to detonate ordnance. Most of the detonation activities at the DR are done by Army personnel on the south ridge.

NAVSURFWARCENDIV conducts detonation of munitions, compressed gas cylinders, suspect inert items, white phosphorus munitions, and lithium batteries at the DR. The DR began operations during the 1940s.

The existing detonation unit consists of 70 subunits (pits). Generally, 500 pounds of net explosive weight per pit are detonated between late spring and early fall, and 250 pounds of net explosive weight per pit are detonated between early fall and late spring. The maximum amount of material treated per week (seven days) is 245,000 pounds. On the average, material treated is 87,500 pounds per week (five days).

2.4 OLD RIFLE RANGE (SWMU #07/09)

The Old Rifle Range (ORR) is a 10-acre site near the center of the facility (Figure 2-2; A.T. Kearney, Inc., 1987). Open burning/flashing of explosive wastes is conducted at the ORR. The flashing operations were originally carried out in earthen containment structures or flash pits. Today, earth-filled steel pans are used (USACE, 1991). The area has also been used for "bomb cook-off" tests (A.T. Kearney, Inc., 1987).

Most of the open burning activity that takes place at the ORR is thermal treatment of projectiles loaded with ammonium picrate (also known as Composition D, Comp D, or "yellow D"). The remaining contamination is removed by providing an open fire under and around the projectiles.

Adjacent to the flash pits is a rifle range that had been used in the past on occasion for small arms practice by base personnel. Currently, this area is seldom used.

3.0 ENVIRONMENTAL SETTING

3.1 INTRODUCTION

NAVSURFWARCENDIV is located in southwestern Indiana, approximately 40 miles southwest of Bloomington, Indiana (Figure 2-1). The site encompasses more than 100 square miles. It is located in a rural sparsely populated area. Forest covers most of NAVSURFWARCENDIV with the surrounding acreage either wooded or farmed land.

The site is located in a temperate climate zone displaying a wide temperature range among seasons. The area receives an average of 44 inches of precipitation annually, with 42 inches of rainfall and 15 inches of snowfall (NEESA, 1983). The prevailing wind is from the South-Southwest (McElrath, 1988).

The topography at NAVSURFWARCENDIV consists of undulating terrain dissected by many small drainage ways (Figure 2-2). The elevation of the site ranges from 470 feet above mean sea level (MSL) at a southern drainage way to 860 feet above MSL on a ridge in the west-central portion of the site. V-shaped drainage ways in the north progress to 2,000-foot-wide flood plains in the south and rise to approximately 150 to 200 feet to the ridge lines (NEESA, 1983).

Six creeks receive drainage in five separate drainage basins at NAVSURFWARCENDIV (Figure 2-2). The six creeks are: Furst Creek, Sulphur Creek, Little Sulphur Creek, Boggs Creek, Turkey Creek, and Seed Tick Creek. Surface drainage from NAVSURFWARCENDIV eventually empties into the east fork of the White River, south of the facility. Situated within Crane are Lake Greenwood and several ponds. Lake Greenwood is the main source of water at NAVSURFWARCENDIV and is also used for recreation (NEESA, 1983). Each of the three SWMUs addressed in this memorandum is in a different drainage basin (separated by divides) from that of Lake Greenwood. Surface water flow within each of the three SWMUs is to the South, away from Lake Greenwood.

3.2 SOIL

Four soil units have been mapped at NAVSURFWARCENDIV in the Soil Survey of Martin County, Indiana (McElrath, 1988), including Wellston-Gilpin, Wellston-Berks-Gilpin, Wellston-Berks-Ebal, and Wakeland-

Wilbur-Haymond soils. These soils are primarily silt loams with permeabil ities ranging from 0.6 and 2.0 in/hr (McElrath, 1988).

Detailed soil mapping (McElrath, 1988) in the vicinity of the ABG shows the presence of primarily two soil units: Burnside loam and Wellston-Berks-Gilpin complexes (18 to 70 percent slopes).

Detailed soil mapping near the DR (McElrath, 1988) shows the area to be covered primarily by Zanesville-Udorthents complex soils and Wellston-Gilpin complex soils.

At the ORR, the northern portion of the site is covered with occasionally flooded Burnside loam, the western portion with Wellston silt loam, and the eastern portion with frequently flooded Haymond silt loam (McElrath, 1988).

3.3 GEOLOGY

NAVSURFWARCENDIV is located in the eastern flank of the Illinois Basin. Beneath unconsolidated colluvial and alluvial deposits, Paleozoic age sedimentary rocks underlying NAVSURFWARCENDIV have been deformed to yield a gentle dip of 50 feet per mile toward the west-southwest.

The bedrock surface at NAVSURFWARCENDIV is made up of Lower Pennsylvanian and Upper Mississippian-age sandstones, limestones, and shales.

In general, Mississippian-age Chester Series sandstones, shales, and limestones are exposed in the valley walls of eastern portions of NAVSURFWARCENDIV and in the lower elevations of deep valleys in the western portions. Pennsylvanian-age Mansfield Formation sandstone, siltstones, claystones, and shale are found at the crests of hills and ridges in eastern portions of NAVSURFWARCENDIV and as the surficial bedrock unit farther west. The contact between the Mississippian units and overlying Pennsylvanian units is an unconformity formed by the long-term erosion of the Mississippian surface (Murphy and Ciocco, 1990).

The bedrock surface beneath the ABG is composed of sandstone, shale, and limestone of the Pennsylvanian-age Raccoon Creek Group and the Upper Mississippian-age Stephensport Group.

Bedrock occurs between two and 13 feet below a ground surface at the DR (Dunbar, 1982). Borings completed by WES reveal that bedrock consists of interfingered and interbedded sandstone, shale, and coal

seams from the Mansfield Formation of the Pennsylvanian-age Raccoon Creek Group. The shale and sandstone are thinly interbedded in nearly equal proportions.

The ORR is situated next to the DR, but lower within the stratigraphic sequence than the DR. Bedrock underlying the ORR consists of the Mansfield Formation of the Pennsylvanian-age Raccoon Creek Group (as at the DR) and the Golconda/Haney Formation and Big Clifty Formation of the Mississippian-age Stephensport Group.

3.4 HYDROGEOLOGY

In the unglaciated southwest portion of Indiana, groundwater in general is contained in joint openings of limestone and sandstone aquifers. The following rock units are considered aquifers in the eastern portion of NAVSURFWARCENDIV: Golconda/Haney Formation (Upper Aquifer), Big Clifty Formation - Lower Member and Beech Creek Formation (Middle Aquifer), and Beaver Bend Formation (Lower Aquifer) (Hunt, 1988; Murphy and Ciocco, 1990). Although unit thicknesses may vary, the distribution of bedrock units at NAVSURFWARCENDIV suggests similar aquifer characteristics throughout the facility. Surficial unconsolidated aquifers are thin and have limited potential as water supplies.

Aquifers beneath NAVSURFWARCENDIV are considered vertically isolated from each other by interlayered shale beds that act as aquitards. Groundwater recharge occurs where aquifer units outcrop. After entering an aquifer outcrop, groundwater flows by gravity down the dip of the aquifer unit. Since the regional dip of rock units is to the Southwest, regional groundwater flow in all aquifers is directed toward the Southwest. Local variations in bedding, dip, aquifer and aquitard, incision by surface drainage, and karstic conditions cause local groundwater movement at NAVSURFWARCENDIV to differ from regional trends, however. Where erosion resulting from surface drainage has cut through aquifer units, springs and seeps are produced which locally complicate groundwater flow. Springs and seeps are prevalent at contacts between aquicludes and overlying aquifers. Groundwater flowing from springs and seeps into surface water can potentially re-enter the groundwater system as recharge to a lower aquifer outcropping downstream.

In the eastern portion of NAVSURFWARCENDIV, Hunt (1988) hypothesized that karstic conditions are present primarily in major drainage valleys where erosion has cut into permeable sandstones overlying the easily dissolved Beech Creek Limestone.

Groundwater from the Golconda/Haney flows into the ABG by seepage eastward along the top of the underlying Indian Springs Shale. Groundwater seeping from the Golconda/Haney eventually infiltrates the Big Clifty/Beech Creek aquifer at ABG (Hunt, 1988).

The Big Clifty sandstone is hydraulically connected to the Beech Creek Limestone. Surface water enters the Big Clifty Sandstone outcrop in the central part of the ABG and migrates to the Beech Creek Limestone aquifer.

Groundwater in the Beech Creek enters the ABG from the North-Northwest. Primary groundwater flow at the AGB is to the East and South down the Little Sulphur Creek drainage way. Secondary groundwater flow components are to the Southwest and South through Johnson Hollow.

Dye trace studies performed by WES (Murphy and Ciocco, 1990; Murphy, 1992b) showed that Spring A, located approximately 1.5 miles south of the ABG, and Little Sulphur Creek below Spring A are prime outlets for groundwater originating at the ABG.

Groundwater elevation data, obtained in 1991 at the DR, depict a water table that mirrors the surface topography. Flow in the Big Clifty-Beech Creek is generally to the South and Southwest, but locally flows southeast toward Turkey Creek near the Old Rifle Range. The shape of the water table in the northeast corner of the SWMU deviates from the regional trend. The deviation is caused by drainage of the part of the Big Clifty-Beech Creek aquifer close to near-surface flow. That near surface flow is through the alluvial soils at the Old Rifle Range (Murphy and Wade, 1994b).

The uppermost occurrence of groundwater over much of the ORR is within the alluvium. Groundwater elevations within the underlying Big Clifty-Beech Creek aquifer are similar to those in the alluvium. The two units are hydraulically connected at ORR and therefore considered one unconfined aquifer (Murphy and Wade, 1994b). Groundwater flow beneath the ORR is primarily to the East-Southeast, toward Turkey Creek. The occurrence and movement of groundwater are closely tied to the bedrock surface (U.S. Army, 1991).

4.0 SITE DATA ANALYSIS

4.1 AMMUNITION BURNING GROUND

4.1.1 Soil

As part of an RFI at NAVSURFWARCENDIV, a multi-phased Release Characterization Study was conducted by the USACE at ABG (Murphy, 1992a). The purpose of this particular study was to identify the nature, degree and extent of hazardous constituents in the soil at this SWMU.

In 1990, the Part I soil samples collected at ABG consisted of 12 borings throughout the SWMU (Figure 4-1). Soil samples were generally taken at the following depth intervals: 3-6 inches, 12-18 inches, 18-24 inches, 36-42 inches and 6 inches above the top of bedrock. Forty-one (41) soil samples were analyzed for explosives, inorganics, volatile, and semivolatile organics and pesticides/herbicides by the Corps of Engineers laboratory (Table 4-1). In general, the contaminants found in the highest concentrations were explosives (2,4-DNT, 2,6-DNT, TNT, Tetryl, DNB, TNB, RDX and HMX) and metals (Sb, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn, Al, Co, Mg, Mn, Sn). Other contaminants found at much lower concentrations included other inorganics, polycyclic aromatic hydrocarbons (PAHs), volatile organics, and pesticides/herbicides.

Then, in 1993, an additional 33 surface soil grab samples were taken and 32 soil borings were drilled at ABG by Corps of Engineers as part of the Part II study (U.S. Army, 1995) (Figure 4-1) to determine the extent of soil contaminants identified in the Part 1 RFI soils investigation (1990). Samples from the borings were taken at specified depths (0-30", 30-60", 60-90", and/or at refusal). These soil samples were analyzed for volatile organic chemicals, PAHs, explosives, and inorganics, principally metals, by the Corps of Engineers Laboratory.

VOCs were detected in several surface and subsurface ABG soil samples. Highest concentrations of VOCs were the cis- and trans-isomers of 1,2-dichloroethylene (2.3 mg/kg and 0.29 mg/kg, respectively) and trichlorethylene (0.2 mg/kg). Maximum concentrations occurred at the depth of approximately 30 to 90 inches bgs. Surface VOCs were scattered among several locations. In deeper soil samples, VOCs occurred only in the area of the contaminated burn pads. Several explosives were detected in surface and subsurface soil samples. RDX, TNT and HMX were the most significant in terms of maximum concentrations determined. RDX and TNT occurred in concentrations greater than 1,000 mg/kg and HMX in concentrations greater than

100 mg/kg. The remaining explosives had maximum concentrations generally less than 10 mg/kg. PAHs were detected in surface and subsurface soils in concentrations that were generally less than 1 mg/kg total PAH (sum of all detectable PAHs).

Several inorganic constituents had consistently higher concentrations in site soil than in the background soil database collected by the Corps of Engineers. Constituents in surficial soil samples (samples taken at less than two feet deep) that were more than two orders of magnitude higher than their mean background concentrations were scattered widely across the ABG valley floor. These constituents include cadmium, copper, lead, zinc, and tin. If one order of magnitude is used as the criterion for comparison purposes, this site-related constituent list is expanded to include magnesium, mercury, nickel, and silver and most ABG sample locations are included.

Based on the original review of these data for the RAWP, Brown & Root Environmental Team recommended only limited supplemental soil sampling. It was noted that none of the soil samples previously collected were analyzed for chlorinated dioxins and furans (PCDD/PCDF), and that no soil samples had been collected from the Old Jeep Trail Area. Brown & Root Environmental Team, therefore, collected three surface soil samples from around the burn pans and pads in 1995 and analyzed these soils for PCDD/PCDF (Figure 4-1). Five surface soil samples were also collected in 1995 at the Old Jeep Trail Area (Figure 4-2). These samples were analyzed for explosives, inorganics and semivolatile organics. All of the 1995 samples were sent to Southwest Laboratories for analysis (Table 4-1).

Based on the data validation memorandum issued by USEPA (1997), all of the non-explosive data from the Corps of Engineers laboratory must be rejected due to incomplete QC documentation. With respect to this environmental medium at ABG, the only valid data remaining for the risk assessment are therefore the surface and subsurface explosives data from the 1990 and 1993 Corps of Engineers samples, the three Brown & Root Environmental Team surface dioxin/furan samples collected in 1995, and the five surface soil samples collected from the Jeep Trail Area. From a risk assessment perspective, this existing database is inadequate for the characterization of potential risks associated with the non-explosives contaminants in soil at this SWMU. There are now no data for contaminant concentrations in surface or subsurface soils at ABG proper with respect to inorganics, volatile and semivolatile organics, and pesticides/PCBs.

Our recommendation is to resample soil at this SWMU. A sampling plan has been proposed to meet the following objectives:

- achieve at least a 20 percent confirmation database for this medium;
- select areas for contaminant confirmation where the highest concentrations of contaminants have been reported in the past;
- select areas for confirmation where little to no contamination was detected in the past so as to define the extent of contamination; and
- select a sufficiently representative number of samples for the risk assessment in case contaminant confirmation is not found.

The sample locations selected and the analyses recommended for soil at ABG are provided in Section 5.1 of this memorandum.

4.1.2 Surface Water/Sediment

Surface water and sediment sampling in Little Sulphur Creek was also conducted near ABG as part of the RFI for ABG that was prepared by USACE (U.S. Army, 1992). The purpose of this sampling was to evaluate the degree and extent of potentially hazardous constituents in surface water and sediments related to past activities at ABG.

Eleven locations were selected by USACE for two sampling events (Figure 4-3). The 11 locations included three background (upstream) samples, three on-SWMU location samples and five locations situated progressively downstream of ABG (and ultimately downstream of the Jeep Trail Area) along Little Sulfur Creek. In general, the samples were analyzed for inorganic and organic constituents, explosives and pesticides/PCBs by the Corps of Engineers laboratory (Tables 4-2 and 4-3).

The results of the two sampling rounds indicated that potential contaminants were detected less frequently in surface water than in sediment, but that several inorganic constituents (Al, Ba, Mg, Mn, NO_4) were detected at most locations. Three explosives (2,4-DNT, HMX and RDX) were detected in the downstream surface water samples. The greatest frequency of surface water detections, as well as the highest parameter concentrations occurred in samples ABG-7 and ABG-8, at locations directly downstream of the Jeep Trail Area.

Upon review of these data for the RAWP, Brown & Root Environmental Team recommended that several additional surface water and sediment samples be taken. Specifically, that two new sampling locations be evaluated to address potential impacts near the Jeep Trail Area (ABG-12, ABG-13). In addition, three

additional upstream background samples were taken to expand this database for the risk assessment (resampling at/near ABG-1 and ABG-14, ABG-15). Inorganics, volatile and semi-volatile organics, explosives and pesticides were evaluated in all of these supplemental samples by Southwest Laboratories.

For the purposes of the RAWP, the site surface water and sediment data were subdivided into the following groups:

Upstream ABG	On-SWMU	Downstream ABG
ABG-1	ABG-4	ABG-7
ABG-2	ABG-5	ABG-8
ABG-3	ABG-6	
ABG-14		
ABG-15		

Jeep Trail Area	Downstream Little Sulphur Creek
ABG-12	ABG-9
ABG-13	ABG-10
	ABG-11

Based on the data validation memorandum issued by USEPA (1997), all of the non-explosives surface water and sediment analyses conducted by the Corps of Engineers laboratory must be rejected. With respect to these two environmental media at ABG, the only valid data now remaining for the risk assessment are the 1990 Corps of Engineers explosives data (11 sites), the six Brown & Root Environmental Team background (upstream) surface water and sediment samples (ABG-1, ABG-14, ABG-15 of Figure 4-3), and the four Brown & Root Environmental Team surface water and sediment samples collected in the Jeep Trail Area (ABG-12, ABG-13 of Figure 4-3). From a risk assessment perspective these existing two databases are inadequate for the characterization of potential risks associated with surface water/sediment exposure. There are no data for surface water and sediment contaminants at the ABG and downstream locations along Little Sulphur Creek (with the exception of the small region near the Jeep Trail Area) with respect to inorganics, volatile, and semi-volatile organics and pesticides/PCBs. The explosives data are now also four years old.

Our recommendation is to resample both surface water and sediment at this SWMU. A sampling plan has been proposed to meet the following objectives:

- achieve at least a 20 percent confirmation database for these media;
- select areas for contaminant confirmation where the highest concentrations of contaminants have been reported in the past;
- select areas for confirmation where little to no contamination was detected in the past so as to define the extent of contamination;
- select a sufficiently representative number of samples for the risk assessment in case contaminant confirmation is not found; and
- because two interconnected environmental media are involved, sampling locations are selected where both media are impacted (or not impacted).

4.1.3 Springs

Also as part of the USACE RFI for ABG (Murphy and Wade, 1994a), seven regional springs were sampled for water quality parameters on six occasions (Figure 4-4). One of these springs (Spring A) was sampled an additional seventh time. The springs were sampled in order to evaluate the potential for groundwater discharges (primarily from the Beech Creek aquifer) to surface water south of ABG and the Jeep Trail Area.

Springs A, B, and C are located along the southern portion of Little Sulphur Creek valley, south of ABG and the Jeep Trail Area. Springs D, E, F and Mountain Spring are located north of ABG. All samples were analyzed for explosives, inorganics, volatile and semivolatile organics, and water quality parameters by Anacon for the RFI (Table 4-4).

Since the RFI, Springs A, B and C have been sampled four additional times: by Anacon (once in 1993 and in 1994), by Enseco (once in 1993), and once by Synergic Analytics in 1995.

In general, the contaminants found in samples collected from the springs located south of ABG included TCE, RDX, TNT, and barium. Detections in the northern springs included TCE, di-n-butylphthalate, RDX, mercury and methoxychlor. Because dye tracer studies did not suggest a link between Beech Creek groundwater at ABG and the northern springs, the source of the contaminants detected in the northern springs is not likely ABG.

Brown & Root Environmental Team in the RAWP recommended that this database be supplemented to address current data deficiencies (e.g. certain metals, cyanide, and SVOCs). Spring A was selected for sampling for inorganics, volatile and semi-volatile organics and explosives. Springs B and C were selected

for sampling for metals, cyanide, semi-volatile organics and explosives. In addition, Brown & Root Environmental Team suggested sampling two off-facility springs, Spring 8 and Spring 10, since no analytical data currently existed for either of these two springs. All samples were taken in 1995 and analyzed by Southwest Laboratories for explosives, inorganics, volatile and semi-volatile organics. (Table 4-4).

Based on the data validation memorandum issued by USEPA (1997), all of the spring water data reported by Anacon must be rejected and all of the water quality data reported by Synergic Analytics must be rejected. With respect to this environmental medium at ABG, the only valid spring water data remaining for the risk assessment are the 1993 data by Enseco (Springs A, B and C) and the 1995 data by Brown & Root Environmental Team (Springs A, B, C, 8, 10). No data exist for the four upgradient springs (Mnt, D, E, F).

However, since none of the northern springs are believed to be hydraulically connected to ABG (Beech Creek aquifer), the loss of these data from the risk assessment database is not viewed as significant. Therefore, no additional confirmational sampling is recommended for this medium at ABG, as the remaining valid data (Brown & Root Environmental Team, 1995 data) are expected to adequately characterize the potential risks associated with site-related contaminants in the southern springs.

4.1.4 Groundwater

As part of the RFI for ABG, a multi-phase Groundwater Release Characterization Study was conducted by USACE (Murphy, 1992b). The purpose of this study was to evaluate the hydrogeology and the degree and extent of chemical release to groundwater at ABG. A total of 98 monitoring wells exist at ABG. Seventy-one (71) of these wells have been sampled on a semi-frequent basis since 1987. Analytical parameters selected were referred to as RCRA Group 1 parameters, RCRA Group 2 parameters, RCRA Group 3 parameters, explosives, organics and PCBs (see RAWP for list of chemicals included in each group). For the RAWP, Brown & Root Environmental Team noted that this database lacked cyanide and ten (10) metals (Al, Sb, Be, Co, Cu, Ni, Tl, Sn, V, Zn) and that only four SVOCs were included. In addition, only six pesticides and three explosives were being routinely monitored. Over this period of time, several laboratories have been contracted to perform the sampling and analysis. These included: Anacon, Enseco and Synergic Analytics.

With respect to the existing data, it appears that the Beech Creek aquifer is the most significantly impacted groundwater at ABG. It is also the most important hydrogeological unit in terms of off-site migration of contaminated groundwater. Consistently detected contaminants included: TCE, RDX, and barium.

As part of the RAWP, Brown & Root Environmental Team suggested supplemental sampling of groundwater at ABG. The RAWP grouped the ABG monitoring wells by aquifer and/or geologic unit and then evaluated the reported contamination in each of the groups individually. The four main aquifers and/or geologic units that have been identified at ABG are from the deepest to the shallowest:

- Beaver Bend limestone
- Big Clifty sandstone/Beech Creek limestone
- Golconda limestone
- Alluvium

Beaver Bend

The Beaver Bend aquifer is the deepest groundwater unit that is currently monitored at ABG. All five of the existing wells screened in this unit are on-SWMU (Figure 4-5). Beaver Bend sampling has occurred over an eight year period (Table 4-5). Anacon has been the primary laboratory that has conducted these water analyses. However, past data have been obtained from both Synergic Analytics and Enseco. The data collected by Enseco are acceptable for use in the risk assessment.

TCE has been detected in this aquifer on several occasions in most of these wells. The greatest reported TCE detections (and the highest level) occurs in well 03C09 (1-20 μg/L) prior to 1992, located north of the main activity area and upgradient from the SWMU. RDX was also reported in this well at 230 μg/L.

Brown & Root Environmental Team viewed these data in the RAWP and concluded that they were sufficient for the RA. Therefore, no additional Beaver Bend sampling was recommended.

Based on the data validation memorandum issued by USEPA (1997), all of the Anacon and Synergic Analytics data must be rejected. With respect to this environmental medium at ABG, the valid data remaining for the risk assessment are the 1993 (one round for wells 03C03, 03C08A, 03C09) data obtained by Enseco. From a risk assessment perspective, these existing data should be supplemented with analytical data from well 03C01 due to its past detections of explosives.

Our recommendation is to resample this specific ABG well in the Beaver Bend aquifer (see Table 5-3).

Beech Creek

This groundwater unit has the most wells screened in it at ABG. For the purposes of the RAWP, the Beech Creek aquifer monitoring wells were grouped by general location relative to ABG. These nine groups are as follows:

On-SWMU (Figure 4-6)

North-Northwest Corner:	03C16, 03C09P2
Western Third:	03C14, 03C10, 03C01P2, 03C20. 03C21
Eastern Two-thirds:	03C03P2, 03C11, 03C04, 03C06, 03C07, 03C08AP2, 03-04, 03-06, 03-35, 03-37, 03C02P2, 03C12, 03C27, 03-36

Off-SWMU (Figures 4-6, 4-7, 4-8, 4-9, 4-10)

Jeep Trail/ Little Sulphur Creek:	03-10, 03-11, 03-12, 03-13, 03-14, 03-15, 03-16, 03-17, 03-18, 03-20, 03-21, 03-22, 03-23, 03-24, 03-25
Downgradient Perimeter/ Little Sulphur Creek	03C37, 03B10, 03C38
Downgradient East/ Southeast:	03C28, 03C05, 03C34, 03C35, 03C36
Downgradient Southwest:	03C15, 03C24, 03C25, 03C29, 03C30, 03C31, 03C33
Upgradient North:	03C26, 03C13, 03C17, 03C19, 03C32
Northeast:	02C10, 02C11, 02C12, 02C14, 02C20, 02C22

The North-Northwest Corner group is upgradient to ABG. The Western Third group includes the wells located in the area which is overlain by the Indian Springs Shale member of the Big Clifty Formation. The Eastern Two-thirds group includes the wells along the valley axis where the Indian Springs shale is absent. Sampling and analyses of all of these wells has been conducted frequently since 1987. The primary laboratory involved in the analysis prior to 1993 has been Anacon (Table 4-6). Enseco sampled select wells in these groups in 1993, and Synergic Analytic sampled wells in 1994 and 1995. Anacon also sampled in 1994.

Well 03C09P2 is located on the upgradient side of ABG. Historically, the highest TCE levels have been detected in this well for this side of the site. TCE has been detected consistently at concentrations of 51-136 μg/L. In addition, the explosive RDX has been frequently detected in this well, at levels of 20-70 μg/L.

Five wells located on-site seem to be the most representative of groundwater quality beneath the eastern two-thirds of ABG:

- 03C03P2
- 03C08AP2
- 03C11
- 03C20
- 03C02P2

Well 03C03P2 has demonstrated persistent and elevated detections of TCE (usually above 100 μg/L). Three explosives have also been detected in this well, including the highest RDX concentrations on-site (709 μg/L). Well 03C11 has demonstrated the second highest TCE detections after 03C20. Well 03C02P2 is located in the eastern-most portion of ABG, in an area believed to be characterized by a high gradient, high-flow velocity Karst conduit system. TCE and RDX have been consistently detected in this well, but at low concentrations.

Brown & Root Environmental Team did not recommend in the RAWP any supplemental sampling of these Beech Creek aquifer monitoring wells, except for well 03C17 (an upgradient background well) and wells in the Jeep Trail Area, since only a limited and incomplete database exists for this area. All wells in the Jeep Trail Area were first evaluated for integrity, and then those with established integrity were sampled in 1995 to develop a database for the risk assessment (Table 4-6). Southwest Laboratories conducted all of these analyses.

Based on the data validation memorandum issued by USEPA (1997), all of the Anacon and Synergic Analytic data must be rejected. With respect to this environmental medium at ABG, the only valid data remaining for the risk assessment are the 1993 Enseco data (23 wells) and the 1995 Brown & Root Environmental Team

data (4 wells). From a risk assessment perspective, these existing data are inadequate to characterize current potential risks associated with groundwater due to their limited coverage of the SWMU.

Our recommendation is to resample specific ABG wells in the Beech Creek aquifer. A sampling plan has been proposed to meet the following objectives:

- achieve at least a 20 percent confirmation database for this medium;
- select areas for contaminant confirmation where the highest concentrations of contaminants have been reported in the past;
- select areas for confirmation where little to no contamination was detected in the past so as to define the extent of contamination; and
- select a sufficiently representative number of samples for the risk assessment in case contaminant confirmation is not found.

The well locations selected and the analyses recommended for these Beech Creek wells are provided in Section 5.1 of this memorandum.

Big Clifty

A limited number of Big Clifty wells are present at ABG (Figure 4-9). For some of these wells, the screened interval apparently includes the contact zone with the underlying Beech Creek limestone. Sampling and analyses of these wells has occurred since 1987 (Table 4-7). Anacon was the primary laboratory involved.

TCE has been consistently detected in several of these Big Clifty wells. RDX has also been detected on multiple occasions.

Brown & Root Environmental Team did not recommend any additional sampling of the Big Clifty wells in the RAWP.

Based on the data validation memorandum issued by USEPA (1997), all of the Anacon data must be rejected. With respect to this environmental medium at ABG, no valid data remain for the risk assessment. However, due to the direct connection between the Big Clifty sandstone and the Beech Creek limestone, no additional wells in this aquifer were selected for resampling. The Beech Creek wells previously selected provide sufficient data to assess this combined aquifer unit.

Golconda

The Golconda limestone occurs near the northern, southern and western edges of ABG. This unit has been removed by erosional processes in the central portions of ABG and in the valleys of Little Sulphur Creek and Johnson Hollow.

Historical data exist for all the Golconda wells at ABG and for the three off-SWMU wells (Figure 4-10; Table 4-8). Anacon is the sole laboratory that has sampled these wells. TCE has been detected on multiple occasions in this unit, especially at well 03C22 (maximum = 300 μg/L.)

Brown & Root Environmental Team did not recommend any additional sampling of the Golconda wells in the RAWP.

Based on the data validation memorandum issued by USEPA (1997), all of the Anacon data must be rejected. With respect to this environmental medium at ABG, no valid data remain for the risk assessment.

Our recommendation is to resample specific ABG wells in the Golconda aquifer. A sampling plan has been proposed to meet the following objectives:

- achieve at least a 20 percent confirmation database for this medium;
- select areas for contaminant confirmation where the highest concentrations of contaminants have been reported in the past;
- select areas for confirmation where little to no contamination was detected in the past so as to define the extent of contamination; and
- select a sufficiently representative number of samples for the risk assessment in case contaminant confirmation is not found.

The well locations selected and the analyses recommended for these Golconda wells are provided in Section 5.1 of this memorandum.

Alluvial Wells

All but one of these wells are located south of ABG and the Jeep Trail Area, at the confluence of Little Sulphur Creek and Johnson Hollow (Figure 4-11). The Jeep Trail Area has one alluvial well (03-07; Figure 4-12). As previously noted by USACE (Murphy and Wade, 1994a), groundwater from ABG (primarily within the Beech Creek aquifer) discharges downgradient to springs and to the Little Sulphur Creek alluvium. Therefore, these wells are used to monitor potential impacts to surficial groundwater at the facility boundary. These wells have been routinely sampled from 1987 to 1992 (Table 4-9). Since 1992 only a few select wells have been sampled. Anacon has been the primary laboratory involved, but other labs have sampled recently.

Brown & Root Environmental Team did not recommend any additional sampling of these alluvial wells in the RAWP.

Based on the data validation memorandum issued by USEPA (1997), all of the Anacon and Synergic Analytic data must be rejected. With respect to this environmental medium at ABG, the only valid data remaining for the risk assessment are the 1993 well sample data (03B02) by Enseco and the 1995 Brown & Root Environmental Team sample (03-07). From a risk assessment perspective, these existing data are inadequate to characterize current potential risks associated with alluvial groundwater.

Our recommendation is to resample specific ABG wells in the Alluvium aquifer. A sampling plan has been proposed to meet the following objectives:

- achieve at least a 20 percent confirmation database for this medium;
- select areas for contaminant confirmation where the highest concentrations of contaminants have been reported in the past;
- select areas for confirmation where little to no contamination was detected in the past so as to define the extent of contamination; and
- select a sufficiently representative number of samples for the risk assessment in case contaminant confirmation is not found.

The well locations selected and the analyses recommended for these alluvium wells are provided in Section 5.1 of this memorandum.

4.2 OLD RIFLE RANGE

4.2.1 Soil

ORR is the other NAVSURFWARCENDIV open burning area (besides ABG). Flashing is carried out at this site in flash pits. The USACE conducted an RFI soil investigation at ORR (Murphy and Wade, 1994b) to: 1) describe the soil conditions at this SWMU, 2) identify and characterize the flashing operation residuals, and 3) determine if residues have impacted the environment around the flash pits.

As part of this RFI, thirteen (13) test borings were advanced at the ORR in 1990 to collect soil samples for physical characterization and chemical pollutant identification (Figure 4-13). Soil samples were taken from specific layers within the borings; 0.2 to 0.5 feet bgs, 3 to 6 feet bgs, 12 to 18 feet bgs, 18 to 24 feet bgs, and within 6 feet of the groundwater table. These samples were analyzed by the Corps of Engineers laboratory for explosives, inorganics, volatile and semivolatile organics (Table 4-10).

Some explosive compounds were detected in soil within the flash pits and in nearby areas. ORR soil also contained several VOCs.

Brown & Root Environmental Team recommended in the RAWP that some additional soil sampling at ORR be conducted for the risk assessment. Specifically, three surface soil samples (0-2 feet bgs) were recommended to be collected in the target practice area and analyzed for lead (Figure 4-13). Also, three new background surface soil samples were recommended for collection (Figure 4-13). All six of these samples were collected and analyzed for inorganics, explosives and semivolatile organics (Table 4-10).

Based on the data validation memorandum issued by USEPA (1997), all of the surface and subsurface non-explosive data from the Corps of Engineers laboratory must be rejected due to incomplete QC documentation. With respect to this environmental medium, the only remaining database for soil at ORR consists of the 1990 surface and subsurface explosives data by the Corps of Engineers laboratory (43 soil samples) and the six surface soil samples collected by Brown & Root Environmental Team in 1995.

From a risk assessment perspective, these existing data are inadequate for evaluating potential risks associated with possible non-explosive contamination at this SWMU.

Our recommendation is to resample specific soil locations at this SWMU. A sampling plan has been proposed to meet the following objectives:

- achieve at least a 20 percent confirmation database for this medium;
- select areas for contaminant confirmation where the highest concentrations of contaminants have been reported in the past;
- select areas for confirmation where little to no contamination was detected in the past so as to define the extent of contamination; and
- select a sufficiently representative number of samples for the risk assessment in case contaminant confirmation is not found.

The sample locations selected and the analyses recommended for soil at ORR are provided in Section 5.2 of this memorandum.

4.2.2 Surface Water/Sediment

At the time of the RAWP, no surface water or sediment sampling had been conducted at the ORR or at the DR. Therefore, Brown & Root Environmental Team developed a sampling plan to characterize potential contamination in these media as a result of past waste disposal activities at both of these SWMUs. Figure 4-14 shows the six locations of the surface water and sediment samples collected in 1995 by Brown & Root Environmental Team in Turkey Creek and Boggs Creek. The analytical parameters selected were VOCs, SVOCs, inorganics, explosives, and water quality parameters (Tables 4-11 and 4-12).

Based on the data validation memorandum issued by USEPA (1997), all of the Southwest Laboratories analytical data for this environmental medium at ORR/DR are valid and therefore acceptable for use in the risk assessment. This database is also judged to be adequate to assess the potential risks due to exposure to surface water and sediment in these two creeks.

4.2.3 Groundwater

A hydrogeologic investigation was also conducted by USACE as part of the ORR RFI (Murphy and Wade, 1994b). The purpose of this investigation was to evaluate subsurface conditions at this SWMU with respect to the degree and extent of chemical releases to groundwater from past ORR activities.

Eleven monitoring wells were installed at ORR by USACE in 1982-1984. An additional 19 monitoring wells were installed in 1990. USACE sampled 28 of these wells in four consecutive events in 1991-1992 for the RFI (Tables 4-13 through 4-15). The analytical parameter list was complete. Both Anacon and the Corps of Engineers laboratory conducted the majority of the analyses on these samples.

In general, contaminants detected in groundwater at ORR included metals (in both the Beech Creek limestone and the surficial zone), explosives and nitrate.

In the RAWP, Brown & Root Environmental Team grouped the ORR monitoring wells according to the formation in which they were screened. These groups were:

- Beech Creek limestone (10 wells; Figure 4-15)
- Golconda limestone (2 wells; Figure 4-16)
- Surficial aquifer (16 wells; Figure 4-17)

Brown & Root Environmental Team recommended in the RAWP sampling of seven select monitoring wells in the first two units (06C16, 06C12, 06C18, 06C16P2, 06-17, 06-22, 06C18P2) and the installation of two new wells in the surficial zone near Turkey Creek (06C19 wells; Figures 4-15 and 4-17). All nine wells were sampled in 1995. Analytical parameters included volatile and semi-volatile organics, inorganics, explosives and nitrate. Southwest Laboratories conducted all of the analyses.

Based on the data validation memorandum issued by USEPA (1997), all of the analytical data reported by Anacon and Synergic Analytic and all of the non-explosive data reported by the Corps of Engineers laboratory must be rejected. With respect to this environmental medium at ORR, the remaining data includes:

Beech Creek Aquifer -	1993 Enseco data (7 wells); 1995 Brown & Root Environmental Team data (4 wells); 1991, 1992 Corps explosives data (10 wells)
Golconda Aquifer -	1990, 1991, 1992 Corps explosives data (2 wells)
Surficial Aquifer -	1991, 1992 Corps explosives data (16 wells); 1993 Enseco data (4 wells); 1995 Brown & Root Environmental Team data (5 wells)

From a risk assessment perspective, these existing data are adequate for the surficial aquifer, but not for the other two units. For the Beech Creek aquifer, data are now missing for the potentially metal contaminated well 06C09.

For the Golconda aquifer, only the explosives data from the Corps of Engineers laboratory is valid. Thus, no contaminant information related to metals is available. Brown & Root Environmental Team suggests sampling both of the two wells in this aquifer, 06-21 and 06C16P3.

4.3 DEMOLITION RANGE

4.3.1 Soil

At the time of the RAWP there had been no soil investigation conducted at the DR. Brown & Root Environmental Team recommended eight (8) surface soil composite samples (0-2 feet bgs) be taken from the Army Detonation Area and three surface soil composite samples be taken from the Navy Detonation Area. In addition, three background surface soil samples were recommended. All 14 soil samples were taken in 1995 (Figure 4-18) and analyzed by Southwest Laboratories for explosives, inorganics and semivolatile organics (Table 4-16).

Based on the data validation memorandum issued by USEPA (1997), all of the analytical data for this environmental medium at DR are valid and therefore acceptable for use in the risk assessment.

4.3.2 Groundwater

As part of the USACE's RFI (Murphy and Wade, 1994b), a hydrogeologic investigation was conducted to evaluate subsurface conditions, and the degree and extent of chemical release to groundwater at DR.

Fifteen (15) monitoring wells were installed at DR in 1982, and an additional 14 wells were installed in 1989. USACE sampled 17 of these wells for four consecutive quarterly events in 1992 for the RFI. Wells excluded from the program were the seven wells in the Mansfield Formation located in the southern portion of DR (06-02, 06-03, 06-04, 06-05, 06-09, 06-10, 06-11). For the wells sampled, the analytical parameter list was complete. Anacon was the primary laboratory that conducted these analyses (Table 4-17).

The RAWP grouped these wells according to the geologic unit in which they are screened. These groups were:

- Beech Creek limestone (8 wells; Figure 4-19)
- Intermediate Zone (1 well; Figure 4-20)
- Surficial Zone (19 wells; Figure 4-21)

Anacon and the Corps of Engineers laboratory conducted the majority of sampling and analyses of these wells (Tables 4-17 through 4-19). However, Synergic Analytic and Enseco did provide some data in 1993 and 1995.

In general, the contaminants detected in groundwater at DR were metals (some of which were above MCLs).

Wells recommended for sampling by Brown & Root Environmental Team in the RAWP were selected to be representative of each of these well groupings and to confirm the existing data. Ten (10) wells in all were resampled at DR. These are:

Beech Creek:	06C01, 06C03, 06C06, 06C07
Surficial Zone:	06-01A, 06-07, 06C03P2, 06C04P2, 06C06P2, 06C08P2

Based on the data validation memorandum issued by USEPA (1997), all of the Anacon and Synergic Analytic data and all of the non-explosives data reported by the Corps of Engineers laboratory must be rejected. With respect to this environmental medium at DR, the existing database consists of:

Beech Creek:	1990, 1991 Corps explosives data (8 wells); 1993 Enseco data (7 wells); 1995 Brown & Root Environmental Team data (4 wells)
Intermediate zone:	None
Surficial Zone:	1990, 1991 Corps explosives data (10 wells); 1993 Enseco data (4 wells); 1995 Brown & Root Environmental Team data (6 wells)

From a risk assessment perspective, the four on-site Beech Creek wells are believed to adequately characterize this aquifer at this SWMU.

The one DR intermediate zone well, 06C01P2, has never been sampled since it has always been dry.

The surficial aquifer at DR has been recently sampled by Brown & Root Environmental Team. Six wells were sampled and analyzed in 1995, including 06C08P2 which is upgradient. The wells selected in 1995 are believed to be sufficient for characterizing impacts to this aquifer by this SWMU.

4.4 FACILITY BACKGROUND DATA

4.4.1 Soil

ABG

During the Part 1 RFI Phase III Soils investigation at ABG, three borings were installed in background locations in the southwest portion of the site (borings 01, 02, and 03; see Figure 4-1). The Corps of Engineers laboratory did the sample analyses. No explosives, VOCs, or SVOCs were detected in soil samples from these borings. Several pesticides were detected, but their presence was interpreted to be related to general use of pesticides in the area rather than ABG-specific activities. The samples were therefore considered acceptable to use as ABG soil background. Since these samples were not analyzed for dioxins/furans, background samples collected in 1995 at the DR will serve as dioxin/furan background for ABG. The Corps of Engineers non-explosives database was not considered acceptable for use in this risk assessment. Therefore, it is recommended that three new background surface soil samples (0-2 feet bgs) be taken at ABG (see Table 5-1).

ORR

Soil samples collected from three "control" locations during the 1990 soils investigation contained the highest levels of some metals of all samples collected at the ORR. There was some question, therefore, as to whether or not these samples were truly representative of background conditions at the site. For this reason, Brown & Root Environmental Team collected three new background surface soil samples north (upgradient) of the ORR within the same soil type (Wellston Silt Loam; Figure 4-13). These samples (from locations designated A01 through A03) were analyzed for explosives, metals, and SVOCs. This database is viewed as complete and adequate for the risk assessment.

DR

No soil investigation had been carried out at the DR at the time of the development of the RAWP. Three grab surface soil samples were therefore collected in 1995 by Brown & Root Environmental Team (Figure 4-18; locations A01 through A03) and analyzed for explosives, metals, SVOCs, and dioxins/furans. These three surface soil samples will also serve as the background dioxin/furan samples for ABG. This database is viewed as complete and adequate for the risk assessment.

4.4.2 Surface Water and Sediment

Ammunition Burning Ground

Three background locations (upstream from ABG) were selected for collection of surface water and sediment samples by USACE in 1992 (Figure 4-14; locations ABG1 through ABG3). Two rounds of samples were analyzed for VOCs, SVOCs, metals, and explosives. Only the second round of samples was analyzed for pesticides/PCBs. Brown & Root Environmental Team recommended that the 1992 samples be supplemented with three additional samples. In 1995 location ABG1 was resampled, and samples were also taken from two new locations - ABG14 and ABG15, which are located upstream from ABG1 (Figure 4-3). These most recent background sediment and surface water samples were analyzed for metals, explosives, SVOCs, and VOCs by Southwest Laboratories. These data were judged to be valid and adequate for risk assessment purposes.

ORR/DR

No investigation of surface water or sediment had been carried out at the Old Rifle Range or the Demolition Range at the time of the development of the RAWP. The sampling plan developed by Brown & Root Environmental Team recommended an upstream (background) sample site for Boggs Creek (DR) and for Turkey Creek (ORR). These upstream sample locations are shown in Figure 4-14. One background sediment sample and one background surface water sample were collected from each creek. These samples were analyzed for explosives, metals, SVOCs, and VOCs. These databases are considered complete and adequate for the risk assessment.

4.4.3 Groundwater - ABG

Background wells for each of the four aquifers/geologic units at ABG were preliminarily selected based on their location relative to ABG in consideration of groundwater flow direction.

Beaver Bend

For the Beaver Bend aquifer (Figure 4-5), two existing wells are potential candidate background wells - 03C01 (which is side-gradient to ABG) and 03C09 (which is upgradient to ABG). Both of these wells, however, have exhibited contamination in the past, particularly explosives and volatile organic compounds. Therefore, neither well qualifies as a background well for risk assessment purposes.

However, given the limited contamination in this aquifer, Brown & Root Environmental Team's recommendation is not to install an additional Beaver Bend well at ABG and sample at this location for the purposes of obtaining background aquifer data.

Beech Creek/Big Clifty

For the Beech Creek aquifer (Figure 4-6), three existing wells are potential candidate background wells - 03C17 (upgradient to ABG), 03C09P2 (upgradient to ABG), and 03C07 (side-gradient to ABG). Two of these wells (03C09P2 and 03C07), however, have been found to be contaminated with explosives, volatile and semi-volatile organic chemicals in the past. These wells therefore do not qualify as background wells for risk assessment purposes. Well 03C17, though, has never shown explosives, volatile or semi-volatile contamination. The inorganic concentrations detected are therefore likely to be naturally occurring. Thus, this well can serve as a background water source for the Beech Creek aquifer at ABG, and valid Enseco data are available.

For the Big Clifty aquifer (Figure 4-9), four existing wells are potential candidate background wells - 03-09, 03-38, 03-01 and 03-30 (all upgradient to ABG). Three of these four wells (03-09, 03-38 and 03-01), however, have shown past contamination by explosives and volatile organic chemicals. Well 03-30, although it has been sampled, has never had a sample analyzed for explosives, volatile and semi-volatile organic contaminants. Thus, none of these four wells currently qualify as a background well for the Big Clifty aquifer

at ABG. However, since the Big Clifty aquifer and the Beech Creek aquifer are in direct contact, the Beech Creek background well can serve as background for this aquifer as well.

Our recommendation is to sample well 03-30 and to analyze for the full suites of chemicals for the purpose of obtaining background data for this aquifer at this SWMU (Table 2-4).

Golconda

For the Golconda aquifer (Figure 4-10 in the prior memorandum), five existing wells are potential candidate background wells - 03C18, 03-02, 03C15P3, 03C16, 03C19P3 (all upgradient to ABG). Only one of these wells, 03C16, has a past history of contaminant detections. Well 03-02, however, has not been monitored. Both of these wells thus do not meet the qualification of background wells for the risk assessment of this site. The other three wells, 03C19P3, 03C15P3, 03C18, can serve as the background locations for this aquifer.

Brown & Root Environmental Team, therefore, recommends sampling one of these three wells (03C19P3) for the purpose of obtaining a background database for the Golconda aquifer at ABG (Table 5-9).

Alluvium

All of the monitoring wells except one in the alluvium unit associated with ABG are located at the juncture of Little Sulphur Creek and Johnson Hollow. The other well is located in the middle of the Jeep Trail Area. None of these wells can be considered background wells, and nowhere on the facility is there a location that could serve as a background sampling location for this unit.

Therefore, Brown & Root Environmental Team does not recommend any additional sampling of the groundwater present in the alluvium aquifer near ABG for the purpose of obtaining background information.

4.4.4 Groundwater - ORR

As discussed in Section 4.2.3 of this memorandum, the U.S. Army Corps of Engineers conducted an RFI at ORR which included the sampling of groundwater at 28 locations at this SWMU (Figures 4-13 through 4-15). The Corps of Engineers laboratory and Anacon both conducted analyses on the samples. The analytical parameter list included explosives, inorganics, volatile and semi-volatile organics, and pesticides.

In the RAWP, Brown & Root Environmental Team grouped the ORR monitoring wells according to the geologic formation in which they were screened. Three well groupings were devised:

- Beech Creek limestone (Figure 4-15 in prior memo)
- Golconda limestone (Figure 4-16 in prior memo)
- Surficial aquifer (Figure 4-17 in prior memo)

Brown & Root Environmental Team recommended in the RAWP sampling of seven of these 28 wells, as well as the installation of two new wells in the surficial zone near Turkey Creek. All nine wells were sampled in 1995, and the water analyzed for explosives, inorganics, VOCs and SVOCs by Southwest Laboratory.

For each of these three units, the 06C16 well nest (three wells) is situated upgradient of the SWMU and thus potential background wells. All three of these wells were sampled by Brown & Root Environmental Team in 1995, and all three were found not to contain any explosives, semi-volatile and volatile contamination. Thus, these three wells and the 1995 data associated with them can serve as the background dataset for these aquifers at this SWMU.

Brown & Root Environmental Team, therefore, does not recommend any additional groundwater sampling at ORR for the purposes of obtaining background groundwater information.

4.4.5 Groundwater - DR

As discussed in the prior memorandum (Section 4.3.2), the U.S. Army Corps of Engineers conducted an RFI at DR which included the sampling of groundwater at 17 well locations at this SWMU (Figures 4-19 through 4-21). Anacon laboratory conducted most of the analyses on these samples.

The RAWP also grouped these wells according to the geologic unit in which they were screened. These three groupings were:

- Beech Creek limestone
- Intermediate Zone
- Surficial Zone

Brown & Root Environmental Team recommended in the RAWP that ten (10) of these wells be sampled. All of the recommended wells were sampled in 1995, and the water analyzed for explosives, inorganics, volatile and semi-volatile organics by Southwest laboratory.

For the Beech Creek and surficial zone aquifers, the 06C08 well nest (two wells) is situated upgradient of the SWMU and thus potential background wells. 06C08P2 was sampled by Brown & Root Environmental Team in 1995 and found to be clean (no explosives, VOCs, or SVOCs). Thus, this well and its associated data can serve as background information for the surficial aquifer at DR. Well 06C08 has valid data from Enseco sampling in 1993 that can be used as background information for the Beech Creek aquifer at DR. Its past history has shown this well to be clean.

Only one well has been installed in the intermediate zone at DR, 06C01P2. This well has never been sampled since it has always been dry. Thus, no site data exist for this zone.

5.0 RECOMMENDATIONS

5.1 AMMUNITION BURNING GROUND

Based on Brown & Root Environmental Team's assessment of the valid analytical data remaining, it was concluded that specific supplemental sampling would be needed for soil, surface water, sediment, and groundwater at ABG. The spring data were judged to be complete and adequate.

Soil

The proposed sampling plan for surface soil at ABG involved an initial determination of significant hot spot locations (from the historical data). This determination was conducted by first sorting the analytical data by contaminant and then listing the data for each chemical according to concentration. The maximum concentration reported was then compared to USEPA Region IX's residential PRGs, when available. All locations where exceedances were noted were identified. In the cases where no PRG was available, the locations of the highest contaminant concentrations were identified. This information provided the locations of 'hits' for confirmation.

Also used in this analysis were two additional criteria. First, to confirm low levels of contamination and/or locations where no contamination was identified, additional sampling spots were selected. Secondly, after graphically displaying all the previously sampled locations, any areas at the site where no sampling was selected were located, and the location was recommended for sampling.

Analyte groups selected for each sampling point were based on the past reported chemical contaminants present, and in select instances, full suites of analyses were recommended for completeness.

Table 5-1 presents the recommended sampling for ABG surface and subsurface soil.

Surface Water and Sediment

The proposed sampling plan for surface water and sediment at ABG involved an initial determination of the highest contaminated areas (from the historical data). Then, spacial characteristics were examined for these sites using Figure 4-3.

Analyte groups selected for each medium were based on the past reported chemical contaminants, and in some instances full suites of analytes were recommended.

Table 5-2 presents the recommended sampling for ABG surface water and sediment in Little Sulphur Creek.

Groundwater

The proposed sampling plan for groundwater at ABG involved an initial determination of significant hot spot locations (from the historical data). This determination was conducted similarly to that performed for soil, except that MCLs were utilized instead of USEPA Region IX's PRGs.

Each of the six aquifers at ABG were evaluated independently. Table 5-3 (site wells) and 5-9 (background well) present the recommended sampling for ABG groundwater wells.

5.2 OLD RIFLE RANGE

Based on Brown & Root Environmental Team's assessment of the valid analytical data remaining, it was concluded that specific supplemental sampling would be needed at ORR for soil and groundwater. Both the surface water and sediment databases are assessed to be complete (Table 5-5).

Soil

The proposed sampling plan for soil at ORR involved an identical procedure to that used for soil at ABG. Table 5-4 presents the recommended sampling for ORR surface and subsurface soil.

Groundwater

The proposed sampling plan for groundwater at ORR involved an identical procedure to that used for groundwater at ABG. Table 5-6 presents the recommended sampling for ORR groundwater.

5.3 DEMOLITION RANGE

Based on Brown & Root Environmental Team's assessment of the valid analytical data remaining, it was concluded that no supplemental sampling would be needed for groundwater at DR (Table 5-8). The soil database (Table 5-7) and the surface water and sediment databases (Table 5-5) were also judged to be complete.

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TABLES

Aquifer/Surface Water/Springs Tables Legend

Column Headers=Sampling Event (e.g. 95-09 is September 1995 Event)
Row Headers=Site and Well/Sample Location Name

Sites:
ABG=Ammunition Burning Ground
ORR=Old Rifle Range
DR=Demolition Range

Table Entries=Lab Code:Analyte Group Code (e.g. Sw:E,M,S,V,W)
Shaded Entries will not be used for Risk Assessment purposes

Lab Codes:
An:=Anacon
El:=Waterways Experiment Station Laboratory
En:=Enseco
Sw:=Southwest
Sy:=Synergic
Un:=Unknown Early Lab

Analyte Group Codes:
E=Explosives
M=Inorganics
C=PCBs
P=Pesticides
R=Radionuclides
S=SVOCs
V=VOCs
W=Water Quality Parameters

Other Entries:
N.D.=No Data Available
Destroyed=Well Was Destroyed
Damaged=Well Was Damaged
Dry=Well Was Dry
Not Sampled=Well Was Not Sampled

Table 4-1
Summary of Soil Sample Data
SWMU #03/10 - Ammunition Burning Ground
Naval Surface Warfare Center

Soil Sample ID	Laboratory/Date; Number and Depth of Samples; Analytes
03/10-1-90-1 through 03/10-12-90-1 03/10-1-90-2 through 03/10-08-90-2; 03/10-10-90-2; 03/10-12-90-2 03/10-10-90-3; 03/10-12-90-3	EI/1990 24 Surface samples from 12 borings E,M,V,S,P
03/10-9-90-2; 03/10-11-90-2 03/10-2-90-3 through 03/10-6-90-3; 03/10-9-90-3; 03/10-11-90-3 03/10-2-90-4; 03/10-4-90-4; 03/10-6-90-4; 03/10-7-90-4; 03/10-10-90-4; 03/10-12-90-4 03/10-6-90-5; 03/10-10-90-5	EI/1990 17 Subsurface samples from 12 borings E,M,V,S,P
003/10-1-93-1 through 003/10-3-93-1 003/10-5-93-1 through 003/10-17-93-1 003/10-19-93-1 003/10-21-93-1 through 003/10-25-93-1 003/10-28-93-1; 003/10-29-93-1 003/10-31-93-1 through 003/10-38-93-1	EI/1993; 30 Surface samples from 32 borings E,M,V,S
003/10-39-93-1 through 003/10-71-93-1	EI/1993; 33 Grab surface samples E,M,V,S
003/10-5-93-2 through 003/10-7-93-2 003/10-10-93-2 through 003/10-14-93-2 003/10-17-93-2; 003/10-19-93-2 003/10-21-93-2 through 003/10-23-93-2 003/10-25-93-2; 003/10-28-93-2; 003/10-29-93-2; 003/10-34-93-2 003/10-35-93-2; 003/10-38-93-2 003/10-12-93-3; 003/10-17-93-3; 003/10-19-93-3; 003/10-21-93-3 through 003/10-23-93-3 003/10-28-93-3	EI/1993; 25 Subsurface samples from borings E,M,V,S

Table 4-1
Summary of Soil Sample Data
SWMU #03/10 - Ammunition Burning Ground
Naval Surface Warfare Center

Soil Sample ID	Laboratory/Date; Number and Depth of Samples; Analytes
CR95-03-SS-A06-01 through CR95-03-A08-01	Sw/1995 3 Grab surface samples Dioxins/Furans
ABG - Old Jeep Trail Area	
CR95-03SS-A01-01 through CR95-03SS-A05-01	Sw/1995 5 Grab surface samples E,M,S

Notes: E = Explosives; S = SVOCs; V = VOCs; M = Metals; P = Pesticides/PCBs

Table 4-2: ABG - Surface Water Sampling Data

Site	Sample	96-05	95-09	92-07	92-04
ABG	03-SURFWTR-01	Sw:E,M,S,V,W		El:E, M,C,P,S,V,W	El:E, M,P,S,V,W
ABG	03-SURFWTR-02			El:E, M,C,P,S,V,W	El:E, M,P,S,V,W
ABG	03-SURFWTR-03			El:E, M,C,P,S,V,W	El:E, M,P,S,V,W
ABG	03-SURFWTR-04			El:E, M,C,P,S,V,W	El:E, M,P,S,V,W
ABG	03-SURFWTR-05			El:E, M,C,P,S,V,W	El:E, M,P,S,V,W
ABG	03-SURFWTR-06			El:E, M,C,P,S,V,W	El:E, M,P,S,V,W
ABG	03-SURFWTR-07			El:E, M,C,P,S,V,W	El:E, M,P,S,V,W
ABG	03-SURFWTR-08			El:E, M,C,P,S,V,W	El:E, M,P,S,V,W
ABG	03-SURFWTR-09			El:E, M,C,P,S,V,W	El:E, M,P,S,V,W
ABG	03-SURFWTR-10			El:E, M,C,P,S,V,W	El:E, M,P,S,V,W
ABG	03-SURFWTR-11			El:E, M,C,P,S,V,W	El:E, M,P,S,V,W
ABG	03-SURFWTR-12	Sw:E,M,S,V,W			
ABG	03-SURFWTR-13	Sw:E,M,S,V,W			
ABG	03-SURFWTR-14		Sw:E,M,S,V,W		
ABG	03-SURFWTR-15	Sw:E,M,S,V,W			

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Table 4-3
Summary of Sediment Sample Data
SWMU #03/10 Ammunition Burning Ground
Naval Surface Warfare Center

Sediment Sample ID	Laboratory/Date; Number of Samples; Analytes
ABG Proper	
ABG-4 through ABG-6 - On-SWMU sample locations ABG-7 and ABG-8 - Downstream ABG (Off-SWMU)	EI/March 1992 (Round 1); July 1992 (Round 2) 5 Samples each round (10 total) M,V,S,E,P
ABG - Jeep Trail Area	
ABG-12; ABG-13	Sw/1995 2 Samples E,M,S,V
ABG - Little Sulphur Creek	
ABG-9 through ABG-11	EI/March 1992 (Round 1); July 1992 (Round 2) 3 Samples each round (6 total) M,V,S,E,P
ABG - Background (Upstream)	
ABG-1 through ABG-3	EI/March 1992 (Round 1); July 1992 (Round 2) 3 Samples each round (6 total) M,V,S,E,P
ABG-1 - Sulphur Creek ABG-14; ABG-15	Sw/1995 3 Samples E,M,S,V

Notes: E = Explosives; S = SVOCs; V = VOCs; M = Metals; P = Pesticides/PCBs

Table 4-4: ABG - Spring Sampling Data

Site	Well	95-09	95-01/02	94-03	93-08/09	93-01	92-10	92-07	92-04	92-01	91-10
ABG	03-MT-SPRING							An:E,M,P,R,S,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03-SPRING-A	Sw:E,M,S,V,W	Sy:E,M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03-SPRING-B	Sw:E,M,S,V,W	Sy:E,M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,C,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03-SPRING-C	Sw:E,M,S,V,W	Sy:E,M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03-SPRING-D							An:E,M,P,R,S,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03-SPRING-E							An:E,M,P,R,S,W	An:E,M,P,S,V,W	An:E,M,P,R,S,V,W	
ABG	03-SPRING-F							An:E,M,P,R,S,W	An:E,M,P,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03-SPRING-G										
ABG	03-SPRING-08	Sw:E,M,S,V,W									
ABG	03-SPRING-10	Sw:E,M,S,V,W									

Site	Well	91-04	90-02	89-10	89-07	87-12	87-11
ABG	03-MT-SPRING	An:E,M,P,S,V,W		An:E,S,V,W	An:E,S,V	An:E,M,P,R,S,V,W	
ABG	03-SPRING-A	An:E,M,P,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,S,V	An:E,M,P,R,S,V,W	
ABG	03-SPRING-B	An:E,M,P,S,V,W		An:E,S,V,W	An:E,S,V	An:E,M,P,R,S,V,W	
ABG	03-SPRING-C	An:E,M,P,S,V,W		An:E,S,V,W	An:E,S,V	An:E,M,P,R,S,V,W	
ABG	03-SPRING-D	An:E,M,P,S,V,W		An:E,S,V,W	An:E,S,V	An:E,M,P,R,S,V,W	
ABG	03-SPRING-E	An:E,M,P,S,V,W		An:E,S,V,W	An:E,S,V		An:E,M,P,R,S,V,W
ABG	03-SPRING-F	An:E,M,P,S,V,W		An:E,S,V,W	An:E,S,V	An:E,M,P,R,S,V,W	
ABG	03-SPRING-G						An:E,M,P,R,S,V,W
ABG	03-SPRING-08						
ABG	03-SPRING-10						

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Table 4-5: ABG - Beaver Bend Aquifer Wells

Site	Well	95-01/02	94-07	94-03	93-08/09	93-01	92-10	92-07	92-04	92-01	91-10
ABG	03C01							An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
[illegible]	03C02							An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
[illegible]	03C03	Sy:E,M,P,S,V,W	Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C08A	Sy:E,M,P,S,V,W	Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C09	Sy:E,M,P,S,V,W	Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W

Site	Well	91-07	91-04	91-01	90-10	90-07	90-04	90-02	89-10	89-07	89-04
ABG	03C01	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03C02	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03C03	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03C08A	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03C09	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W

Site	Well	89-01	88-10	88-07	88-04	88-02	87-11	87-10
ABG	03C01	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C02	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C03	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C08A	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C09	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W

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Table 4-6: ABG - Beech Creek Aquifer Wells

Site	Well	89-07	89-04	89-01	88-10	88-07	88-04	88-02	87-11	87-10
ABG	02C09									
ABG	02C10									
ABG	02C11									
ABG	02C12									
ABG	02C14									
ABG	02C20									
ABG	02C22									
ABG	03-04	An:E,M,S,V,W		An:E,M,S,V,W		An:E,W		An:E,M,S,V,W		
ABG	03-06	An:E,S,V,W		An:E,M,S,V,W		An:E,W		An:E,M,S,V,W		
ABG	03-08									
ABG	03-10									
ABG	03-11									
ABG	03-12									
ABG	03-13									
ABG	03-14									
ABG	03-15									
ABG	03-16									
ABG	03-17									
ABG	03-18									
ABG	03-19									
ABG	03-20									
ABG	03-21									
ABG	03-22									
ABG	03-23									
ABG	03-24									
ABG	03-25									
ABG	03-35	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03-36									
ABG	03-37	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03B10	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W	
ABG	03C01P2	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C02P2	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C03P2	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C04	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C05	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C06	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C07	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C08AP2	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C09P2	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C10	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C11	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C12	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C13	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C14	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C15	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C16	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W		An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03C17	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C19	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C20	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C21	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C24	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C25	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C26	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W

Table 4-6: ABG - Beech Creek Aquifer Wells

Site	Well	89-07	89-04	89-01	88-10	88-07	88-04	88-02	87-11	87-10
ABG	03C27	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C28	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C29	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C30	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C31	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C32	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W				
ABG	03C33									
ABG	03C34									
ABG	03C35									
ABG	03C36									
ABG	03C37									
ABG	03C38									

I:\CRANEDAT\SUMTABLS\TF4-6.WK4

Table 4-6: ABG - Beech Creek Aquifer Wells

Site	Well	91-10	91-07	91-06	91-04	91-01	90-10	90-07	90-04	90-02	89-10
ABG	02C09			El:E, M,C,P,S,V,W							
ABG	02C10			El:E, M,C,P,S,V,W							
ABG	02C11			El:E, M,V,W							
ABG	02C12										
ABG	02C14			El:E, M,C,P,S,V,W							
ABG	02C20										
ABG	02C22										
ABG	03-04	An:E,M,S,V,W	An:E,M,S,V,W		An:M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03-06	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03-08										
ABG	03-10										
ABG	03-11										
ABG	03-12										
ABG	03-13										
ABG	03-14										
ABG	03-15										
ABG	03-16										
ABG	03-17										
ABG	03-18										
ABG	03-19										
ABG	03-20										
ABG	03-21										
ABG	03-22										
ABG	03-23										
ABG	03-24										
ABG	03-25										
ABG	03-35	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03-36										
ABG	03-37	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03B10	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C01P2	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C02P2	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C03P2	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C04	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C05	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C06	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C07	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C08AP2	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C09P2	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C10	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C11	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C12	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C13	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C14	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C15	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C16	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C17	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C19	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C20	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C21	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C24	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C25	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C26	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W

Table 4-6: ABG - Beech Creek Aquifer Wells

Site	Well	91-10	91-07	91-06	91-04	91-01	90-10	90-07	90-04	90-02	89-10
ABG	03C27	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C28	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C29	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C30	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C31	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C32	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C33										
ABG	03C34	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,P,R,S,V,W	
ABG	03C35										
ABG	03C36										
ABG	03C37	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,P,R,S,V,W	
ABG	03C38										

Table 4-6: ABG - Beech Creek Aquifer Wells

Site	Well	95-09	95-01/02	94-09	94-07	94-03	93-08/09	93-01	92-10	92-07	92-04	92-01
ABG	02C09											
ABG	02C10											
ABG	02C11											
ABG	02C12	N.D.										
ABG	02C14											
ABG	02C20	N.D.										
ABG	02C22	N.D.-dry										
ABG	03-04									An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03-06									An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03-08	N.D.-Destroyed										
ABG	03-10			Sy:E,M,V,W								
ABG	03-11			Sy:E,M,V,W								
ABG	03-12	Sw:E,M,S,V,W		Sy:E,M,V,W								
ABG	03-13			Sy:E,M,V,W								
ABG	03-14			Sy:E,M,V,W								
ABG	03-15	Sw:E,M,S,V,W		Sy:E,M,V,W								
ABG	03-16			Sy:E,M,V,W								
ABG	03-17			Sy:E,M,V,W								
ABG	03-18			Sy:E,M,V,W								
ABG	03-19	N.D.-Destroyed										
ABG	03-20			Sy:E,M,V,W								
ABG	03-21			Sy:E,M,V,W								
ABG	03-22			Sy:E,M,V,W								
ABG	03-23			Sy:E,M,V,W								
ABG	03-24	Sw:E,M,S,V,W		Sy:E,M,V,W								
ABG	03-25			Sy:E,M,V,W								
ABG	03-35									An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03-36	N.D.-Not Sampled										
ABG	03-37									An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03B10		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W		En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	
ABG	03C01P2									An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C02P2		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	
ABG	03C03P2		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C04		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C05		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C06		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C07				Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C08AP2		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C09P2		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C10		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,S,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C11		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C12		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C13									An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C14		Sy:E,M,P,S,V,W		Sy:M,P,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C15		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W		An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C16									An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C17	Sw:E,M,S,V,W	Sy:E,M,P,S,V,W			An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C19									An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C20		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C21									An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C24									An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C25		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C26		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W

Table 4-6: ABG - Beech Creek Aquifer Wells

Site	Well	95-09	95-01/02	94-09	94-07	94-03	93-08/09	93-01	92-10	92-07	92-04	92-01
ABG	03C27		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C28		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C29									An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C30		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C31		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C32									An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C33		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W		An:E,M,V,W			
ABG	03C34	Sw:E,M,S,V,W									An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03C35	N.D.-dry										
ABG	03C36	N.D.-dry										
ABG	03C37		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	An:E,M,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W		An:E,M,P,S,V,W	An:E,M,P,R,S,V,W
ABG	03C38	N.D.-dry										

Table 4-7: ABG - Big Clifty Aquifer Wells

Site	Well	92-07	92-04	92-01	91-10	91-07	91-04	91-01	90-10	90-07	90-04
ABG	03-01	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03-09	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03-26	N.D.-Damaged									
ABG	03-27	N.D.-Damaged									
ABG	03-29										
ABG	03-30									An:M,W	
ABG	03-31	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03-32	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03-33	An:E,M,P,R,S,V,W	An:E,M,S,V,W				An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03-34	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03-38	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W

Site	Well	90-02	89-10	89-07	89-04	89-01	88-10	88-07	88-04	88-02	87-11
ABG	03-01	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W		An:E,W		An:E,M,S,V,W	
ABG	03-09	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W		An:E,W		An:E,M,S,V,W	
ABG	03-26										
ABG	03-27										
ABG	03-29							An:E,W		An:E,M,S,V,W	
ABG	03-30										
ABG	03-31	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W							An:E,S,V
ABG	03-32	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W						An:E,M,S,V,W	An:E,S,V
ABG	03-33	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W						An:E,M,S,V,W	An:E,S,V
ABG	03-34	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03-38	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W

I:\CRANEDAT\SUMTABLS\TF4-7.WK4

Table 4-8: ABG - Golconda Aquifer Wells

Site	Well	92-07	92-04	92-01	91-10	91-07	91-04	91-01	90-10
ABG	03-02	N.D.-Never Sampled							
ABG	03-28	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C01P3	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C08AP3	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C15P3	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C18	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C19P3	An:E,M,P,R,S,W	An:E,M,S,V,W			An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W
ABG	03C21P3	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C22	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03C23	An:E,M,P,R,S,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W

Site	Well	90-07	90-04	90-02	89-10	89-07	89-04	89-01	88-10
ABG	03-02								
ABG	03-28	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W			
ABG	03C01P3	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03C08AP3	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03C15P3	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03C18	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03C19P3	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W		An:E,M,P,R,S,V,W		
ABG	03C21P3	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W			
ABG	03C22		An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03C23	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	

Site	Well	88-07	88-04	88-02	87-11	87-10
ABG	03-02					
ABG	03-28			An:W		
ABG	03C01P3	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C08AP3	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C15P3	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C18	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C19P3			An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C21P3		An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W
ABG	03C22	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	
ABG	03C23	An:E,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	

I:\CRANEDAT\SUMTABLS\TF4-8.WK4

Table 4-9: ABG - Alluvial Aquifer Wells

Site	Well	95-09	95-01/02	94-09	94-07	93-08/09	93-01	92-10	92-07	92-04
ABG	03-07	Sw:E,M,S,V,W		Sy:E,M,V,W					An:E,M,P,R,S,W	An:E,M,S,V,W
ABG	03B01								An:E,M,P,R,S,W	An:E,M,S,V,W
ABG	03B02		Sy:E,M,P,S,V,W		Sy:M,P,S,V,W	En:E,M,C,P,S,V,W	An:E,M,V,W	An:E,M,V,W	An:E,M,P,R,S,W	An:E,M,S,V,W
ABG	03B03								An:E,M,P,R,S,W	An:E,M,S,V,W
ABG	03B04								An:E,M,P,R,S,W	An:E,M,S,V,W
ABG	03B05								An:E,M,P,R,S,W	An:E,M,S,V,W
ABG	03B06								An:E,M,P,R,S,W	An:E,M,S,V,W
ABG	03B07		Sy:E,M,P,S,V,W						An:E,M,P,R,S,W	An:E,M,S,V,W
ABG	03B08								An:E,M,P,R,S,W	An:E,M,S,V,W
ABG	03B09								An:E,M,P,R,S,W	An:E,M,S,V,W

Site	Well	92-01	91-10	91-07	91-04	91-01	90-10	90-07	90-04	90-02
ABG	03-07	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03B01	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03B02	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03B03	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03B04	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03B05	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03B06	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03B07	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03B08	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W
ABG	03B09			An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W	An:E,M,S,V,W		An:E,M,S,V,W	An:E,M,S,V,W

Site	Well	89-10	89-07	89-04	89-01	88-10	88-07	88-04	88-02	87-10
ABG	03-07	An:E,M,S,V,W	An:E,M,S,V,W						An:E,M,S,V,W	
ABG	03B01	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03B02	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03B03	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03B04	An:E,M,S,V,W	An:E,M,P,R,S,V,W		An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03B05	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03B06	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03B07	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03B08	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W
ABG	03B09	An:E,M,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W	An:E,M,P,R,S,V,W

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Table 4-10
Summary of Soil Sample Data
SWMU #07/09 Old Rifle Range
Naval Surface Warfare Center

Soil Sample ID	Laboratory/Date; Number and Depth of Samples; Analytes
07/09-1-90-1 through 07/09-12-90-1 07/09-1-90-2 through 07/09-08-90-2; 07/09-10-90-2; 07/09-12-90-2 07/09-7-90-3; 07/09-10-90-3; 07/09-12-90-3 Note: Borings 12, 11, and 1 labeled "control" locations	EI/1990 25 Surface samples from borings M,E,V,S
07/09-9-90-2; 07/09-11-90-2 07/09-2-90-3 through 07/09-6-90-3; 07/09-9-90-3; 07/09-11-90-3; 07/09-12-90-3 07/09-2-90-4; 07/09-4-90-4; 07/09-6-90-4; 07/09-7-90-4; 07/09-10-90-4; 07/09-12-90-4 07/09-6-90-5; 07/09-10-90-5 Note: Borings 12, 11, and 1 labeled "control" locations **Note: Boring 13 mentioned in text, but not results in tables.**	EI/1990 18 Subsurface samples from borings M,E,V,S
Target Area	
A04 through A06	Sw/1995 3 Grid composite surface samples E,M,S
Background	
A01 through A03	Sw/1995 3 Grab surface samples E,M,S

Notes: E = Explosives; S = SVOCs; V = VOCs; M = Metals; P = Pesticides/PCBs

Table 4-11: ORR/DR - Surface Water Sampling Data

Site	Well	95-09
ORR/DR	07-SURFWTR-T1	Sw:E,M,S,V,W
ORR/DR	07-SURFWTR-T2	Sw:E,M,S,V,W
ORR/DR	06-SURFWTR-T3	Sw:E,M,S,V,W
ORR/DR	06-SURFWTR-B1	Sw:E,M,S,V,W
ORR/DR	06-SURFWTR-B2	Sw:E,M,S,V,W
ORR/DR	06-SURFWTR-B3	Sw:E,M,S,V,W

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Table 4-12
Summary of Sediment Sample Data
Demolition Range/Old Rifle Range
Naval Surface Warfare Center

Sediment Sample ID	Laboratory/Date; Number of Samples; Analytes
Boggs Creek	
CR95-06SD-B-2-01 and CR95-06SD-B-3-01	Sw/1995 2 Samples E,M,S,V
Boggs Creek Background (Upstream)	
CR95-06SD-B-1-01	Sw/1995 1 Sample E,M,S,V
Turkey Creek	
CR95-06SD-T-2-01 and CR95-06SD-T-3-01	Sw/1995 2 Samples E,M,S,V
Turkey Creek Background (Upstream)	
CR95-06SD-T-1-01	Sw/1995 1 Sample E,M,S,V

Notes: E = Explosives; S = SVOCs; V = VOCs; M = Metals; P = Pesticides/PCBs

Table 4-13: ORR - Beech Creek Aquifer Wells

Site	Well	95-09	95-01/02	94-07	94-03	93-07/08	93-01	92-10	92-04	91-11	91-06
ORR	06C09								El:E, M,W	El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W
ORR	06C10								El:E, M,W	El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W
ORR	06C11		Sy:E,M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:E, M,W	El:E, M,C,P,V,W	El:E, M,C,P,S,V,W
ORR	06C12	Sw:E,M,S,V,W	Sy:E,M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:E, M,W	El:E, M,C,P,V,W	El:E, M,C,P,S,V,W
ORR	06C13		Sy:E,M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:E, M,W	El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W
ORR	06C14		Sy:E,M,W		An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:E, M,W	El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W
ORR	06C15		Sy:E,M,W	Sy:M,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:E, M,W	El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W
ORR	06C16	Sw:E,M,S,V,W	Sy:E,M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:E, M,W	El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W
ORR	06C17								El:E, M,W	El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W
ORR	06C18	Sw:E,M,S,V,W	Sy:E,M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:E, M,W	El:E, M,C,P,V,W	El:E, M,C,P,S,V,W
ORR	06C19	Sw:E,M,S,V,W									

Site	Well	91-03	90-11
ORR	06C09		El:E, M,C,P,S,V,W
ORR	06C10	El:E, M,C,P,S,V,W	
ORR	06C11	El:E, M,C,P,S,V,W	
ORR	06C12	El:E, M,C,P,S,V,W	
ORR	06C13		El:E, M,C,P,S,V,W
ORR	06C14		El:E, M,C,P,S,V,W
ORR	06C15		El:E, M,C,P,S,V,W
ORR	06C16		El:E, M,C,P,S,V,W
ORR	06C17		El:E, M,C,P,S,V,W
ORR	06C18		El:E, M,C,P,S,V,W
ORR	06C19		

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Table 4-14: ORR - Golconda Aquifer Wells

Site	Well	92-04	92-01	91-11	91-06	91-01	90-11	90-07	90-02	89-07	85-01
ORR	06-21	El:E, M,W	An:E,M,S,W		El:E, M,C,P,S,V,W	An:E,M,S,W	El:E, M,C,P,S,V,W	An:E,M,W	An:E,M,S,W	An:E,M,S,W	Un:E,M
ORR	06C16P3	El:E, M,W		El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W		El:E, M,C,P,S,V,W				

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Table 4-15: ORR - Surficial Aquifer Wells

Site	Well	95-09	95-01/02	94-07	94-03	93-07/08	93-01	92-10	92-04	92-01	91-11	91-07
ORR	06-14A								El:E, M,W	An:E,M,S,W	El:E, M,C,P,S,V,W	
ORR	06-15								El:E, M,W			
ORR	06-16								El:E, M,W	An:E,M,S,W	El:E, M,C,P,V,W	
ORR	06-17	Sw:E,M,S,V,W							El:E, M,W	An:E,M,S,W	El:M, V,W	
ORR	06-18								El:E, M,W	An:E,M,S,W	El:E, M,C,P,S,V,W	
ORR	06-19								El:E, M,W	An:E,M,S,W	El:E, M,P,S,V,W	
ORR	06-20								El:E, M,W	An:E,M,S,W	El:E, M,C,P,S,V,W	
ORR	06-22	Sw:E,M,S,V,W							El:E, M,W	An:E,M,S,W	El:E, M,C,P,S,V,W	An:E,M,W
ORR	06-23								El:E, M,W	An:E,M,S,W	El:E, M,C,P,S,V,W	An:E,M,W
ORR	06C10P2								El:E, M,W		El:E, M,C,P,S,V,W	
ORR	06C11P2		Sy:E,M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:E, M,W		El:E, M,C,P,V,W	
ORR	06C12P2								El:E, M,W		El:E, M,C,P,V,W	
ORR	06C13P2		Sy:E,M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:E, M,W		El:E, M,C,P,S,V,W	
ORR	06C14P2		Sy:E,M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:E, M,W		El:E, M,C,P,S,V,W	
ORR	06C15P2								El:E, M,W		El:E, M,C,P,S,V,W	
ORR	06C16P2	Sw:E,M,S,V,W							El:E, M,W		El:E, M,C,P,S,V,W	
ORR	06C18P2	Sw:E,M,S,V,W	Sy:E,M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:E, M,W		El:E, M,C,P,V,W	
ORR	06C19P2	Sw:E,M,S,V,W										

Site	Well	91-07	91-06	91-03	91-01	90-11	90-07	90-02	89-07	86-06	86-02	85-01
ORR	06-14A		El:E, M,C,P,S,V,W		An:E,M,S,W				An:E,M,S,W		Un:E,M	Un:E,M
ORR	06-15		El:E, M,C,P,S,V,W		An:E,M,S,W	El:E, M,C,P,S,V,W	An:E,M,W	An:E,M,S,W	An:E,M,S,W			Un:E,M
ORR	06-16		El:E, M,C,P,S,V,W		An:E,M,S,W	El:E, M,C,P,S,V,W	An:E,M,W	An:E,M,S,W	An:E,M,S,W			Un:E,M
ORR	06-17		El:E, M,C,P,S,V,W		An:E,M,S,W	El:E, M,C,P,S,V,W	An:E,M,W	An:E,M,S,W	An:E,M,S,W		Un:E,M	Un:E,M
ORR	06-18		El:E, M,C,P,S,V,W		An:E,M,S,W	El:E, M,C,P,S,V,W	An:E,M,W	An:E,M,S,W	An:E,M,S,W		Un:E,M	Un:E,M
ORR	06-19		El:E, M,C,P,S,V,W		An:E,M,S,W		An:E,M,W	An:E,M,S,W	An:E,M,S,W		Un:E,M	Un:E,M
ORR	06-20		El:E, M,C,P,S,V,W		An:E,M,S,W	El:E, M,C,P,S,V,W	An:E,M,W	An:E,M,S,W	An:E,M,S,W		Un:E,M	Un:E,M
ORR	06-22	An:E,M,W	El:E, M,C,P,S,V,W		An:E,M,S,W	El:E, M,C,P,S,V,W		An:E,M,S,W	An:E,M,S,W	Un:E		Un:E,M
ORR	06-23	An:E,M,W	El:E, M,C,P,S,V,W		An:E,M,S,W	El:E, M,C,P,S,V,W	An:E,M,W	An:E,M,S,W	An:E,M,S,W			Un:E,M
ORR	06C10P2		El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W								
ORR	06C11P2		El:E, M,C,P,S,V,W	El:E, M,C,P,V,W								
ORR	06C12P2		El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W								
ORR	06C13P2		El:E, M,C,P,S,V,W			El:E, M,C,P,S,V,W						
ORR	06C14P2		El:E, M,C,P,S,V,W			El:E, M,C,P,S,V,W						
ORR	06C15P2		El:E, M,C,P,S,V,W			El:E, M,C,P,S,V,W						
ORR	06C16P2		El:E, M,C,P,S,V,W			El:E, M,C,P,S,V,W						
ORR	06C18P2		El:E, M,C,P,S,V,W			El:E, M,C,P,S,V,W						
ORR	06C19P2											

Site	Well	84-02	83-08	83-03	83-01	82-11	82-09	82-07	82-06	82-03	82-01	81-11
ORR	06-14A	Un:E,M,S,W										
ORR	06-15											
ORR	06-16	Un:E,M,S,W	Un:E,W	Un:E,M,S,W			Un:M,P,S,W	Un:W	Un:M,P,S,W	Un:M,P,S,W		Un:M,P,S,W
ORR	06-17	Un:E,M,S,W	Un:E,W	Un:E,M,S,W	Un:W	Un:W	Un:M,P,S,W	Un:M,W	Un:M,P,S,W	Un:M,P,S,W		Un:M,P,S,W
ORR	06-18	Un:E,M,S,W	Un:E,W	Un:E,M,S,W	Un:W	Un:M,W	Un:M,P,S,W	Un:W	Un:W	Un:M,P,S,W	Un:M,P,S,W	
ORR	06-19	Un:E,M,S,W	Un:E,W	Un:E,M,S,W	Un:M	Un:M,W	Un:M,P,S,W	Un:M,W	Un:M,P,S,W	Un:M,P,S,W	Un:M,P,S,W	
ORR	06-20	Un:E,M,S,W	Un:E,W	Un:E,M,S,W		Un:M	Un:M,P,S,W	Un:M,W	Un:M,P,S,W	Un:M,P,S,W	Un:M,P,S,W	
ORR	06-22											
ORR	06-23											
ORR	06C10P2											
ORR	06C11P2											
ORR	06C12P2											
ORR	06C13P2											
ORR	06C14P2											
ORR	06C15P2											
ORR	06C16P2											
ORR	06C18P2											
ORR	06C19P2											

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Table 4-16
Summary of Soil Sample Data
SWMU #06/09 Demolition Range
Naval Surface Warfare Center

Soil Sample ID	Laboratory/Date; Number and Depth of Samples; Analytes
Army Detonation Area	
A07 through A14	Sw/1995 8 grid composite samples E,M,S
Navy Detonation Area	
A04 through A06	Sw/1995 3 Grid composite surface samples E,M,S
Background	
A01 through A03	Sw/1995 3 Grab surface samples E,M,S,Dioxins/Furans

Notes: E = Explosives; S = SVOCs; V = VOCs; M = Metals; P = Pesticides/PCBs

Table 4-17: DR - Beech Creek Aquifer Wells

Site	Well	95-09	95-01/02	94-07	94-03	93-07/08	93-01	92-10	92-04	91-11	91-06
DR	06C01	Sw:E,M,S,V,W							El:M,W	El:E, M,C,P,V,W	El:E, M,C,P,S,V,W
DR	06C02		Sy:M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:M,W	El:E, M,C,P,V,W	El:E, M,C,P,S,V,W
DR	06C03	Sw:E,M,S,V,W	Sy:M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:M,W	El:E, M,C,P,V,W	El:E, M,C,P,S,V,W
DR	06C04		Sy:M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:M,W	El:E, M,C,P,V,W	El:E, M,C,P,S,V,W
DR	06C05		Sy:M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:M,W	El:E, M,C,P,V,W	El:E, M,C,P,S,V,W
DR	06C06	Sw:E,M,S,V,W	Sy:M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:M,W	El:E, M,C,P,V,W	El:E, M,C,P,S,V,W
DR	06C07	Sw:E,M,S,V,W	Sy:M,W	Sy:M,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:M,W	El:E, M,C,P,V,W	El:E, M,C,P,S,V,W
DR	06C08		Sy:E,M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:M,W	El:E, M,C,P,V,W	El:E, M,C,P,S,V,W

Site	Well	91-03	90-11
DR	06C01		El:E, M,C,P,S,V,W
DR	06C02	El:E, M,C,P,S,V,W	
DR	06C03	El:E, M,C,P,S,V,W	
DR	06C04	El:E, M,C,P,S,V,W	
DR	06C05	El:E, M,C,P,S,V,W	
DR	06C06	El:E, M,C,P,S,V,W	
DR	06C07	El:E, M,C,P,S,V,W	
DR	06C08		El:E, M,C,P,S,V,W

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Table 4-18: DR - Intermediate Zone Aquifer Wells

Site	Well	95-09
DR	06C01P2	N.D.-Never Sampled

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Table 4-19: DR - Surficial Zone Aquifer Wells

Site	Well	95-09	95-01/02	94-07	94-03	93-07/08	93-01	92-10	92-04	92-01
DR	06-01A	Sw:E,M,S,V,W							El:M,W	An:E,M,S,W
DR	06-01B	N.D.-Destroyed								
DR	06-01C	Later Destroyed								
DR	06-02									
DR	06-03									
DR	06-04									
DR	06-05									
DR	06-06								El:M,W	An:E,M,S,W
DR	06-07	Sw:E,M,S,V,W							El:M,W	An:E,M,S,W
DR	06-08									
DR	06-09									
DR	06-10									An:E,M,S,W
DR	06-11									An:E,M,S,W
DR	06-12								El:M,W	An:E,M,S,W
DR	06-13									
DR	06C01P3								El:M,W	
DR	06C02P2								El:M,W	
DR	06C03P2	Sw:E,M,S,V,W	Sy:M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:M,W	
DR	06C04P2	Sw:E,M,S,V,W	Sy:M,W	Sy:M,W		En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:M,W	
DR	06C06P2	Sw:E,M,S,V,W	Sy:M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:M,W	
DR	06C08P2	Sw:E,M,S,V,W	Sy:M,W	Sy:M,S,V,W	An:M	En:E,M,C,P,S,V,W	An:E,M,W	An:E,M,W	El:M,W	

Site	Well	91-11	91-06	91-03	91-01	90-11	90-07	90-02	89-07	86-02
DR	06-01A	El:M,V,W	El:E, M,C,P,S,V,W		Un:E,M,S,W	El:E, M,C,P,S,V,W	An:E,M,W	An:E,M,S,W	An:E,M,S,W	Un:E,M
DR	06-01B									
DR	06-01C									
DR	06-02									
DR	06-03									Un:E,M
DR	06-04									
DR	06-05									
DR	06-06	El:E, M,C,P,V,W	El:E, M,C,P,S,V,W		Un:E,M,S,W	El:E, M,C,P,S,V,W	An:E,M,W	An:E,M,S,W	An:E,M,S,W	Un:E,M
DR	06-07	El:E, M,C,P,V,W	El:E, M,C,P,S,V,W		Un:E,M,S,W	El:E, M,C,P,S,V,W	An:E,M,W	An:E,M,S,W	An:E,M,S,W	Un:E,M
DR	06-08									Un:E,M
DR	06-09				Un:E,M,S,W		An:E,M,W	An:E,M,S,W	An:E,M,S,W	Un:E,M
DR	06-10				Un:E,M,S,W		An:E,M,W	An:E,M,S,W	An:E,M,S,W	Un:E,M
DR	06-11				Un:E,M,S,W		An:E,M,W	An:E,M,S,W	An:E,M,S,W	Un:E,M
DR	06-12	El:E,M,C,P,V,W	El:E, M,C,P,S,V,W		Un:E,M,S,W	El:E, M,C,P,S,V,W	An:E,M,W	An:E,M,S,W	An:E,M,S,W	Un:E,M
DR	06-13									Un:E,M
DR	06C01P3	El:E,M,C,P,V,W	El:E, M,C,P,S,V,W			El:E, M,C,P,S,V,W				
DR	06C02P2	El:E,M,C,P,V,W	El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W						
DR	06C03P2	El:E,M,C,P,V,W	El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W						
DR	06C04P2	El:E,M,C,P,V,W	El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W						
DR	06C06P2	El:E,M,C,P,V,W	El:E, M,C,P,S,V,W	El:E, M,C,P,S,V,W						
DR	06C08P2	El:E,M,C,P,V,W	El:E, M,C,P,S,V,W			El:E, M,C,P,S,V,W				

Table 4-19: DR - Surficial Zone Aquifer Wells

Site	Well	85-01	84-02	83-11	83-09	83-08	83-03	83-01	82-11	82-07
DR	06-01A	Un:E,M	Un:E,M,S,W		Un:M	Un:E,W				
DR	06-01B									
DR	06-01C								Un:W	Un:M,P,S,W
DR	06-02	Un:E,M	Un:E,M,S,W			Un:E,W	Un:E,M,S,W	Un:M,W	Un:M,P,R,S,W	Un:M,P,R,S,W
DR	06-03	Un:E,M	Un:E,M,S,W	Un:W		Un:E,W	Un:E,M,S,W	Un:M,W	Un:M,P,R,S,W	Un:M,P,R,S,W
DR	06-04	Un:M	Un:E,M,S,W			Un:E,W	Un:E,M,S,W	Un:W	Un:M,P,R,S,W	Un:M,P,R,S,W
DR	06-05						Un:E,M,S,W	Un:M	Un:M,P,S,W	Un:M,P,S,W
DR	06-06	Un:E,M	Un:E,M,S,W			Un:E,W	Un:E,M,S,W	Un:M,W	Un:M,P,R,S,W	Un:M,P,S,W
DR	06-07	Un:E,M	Un:E,M,S,W			Un:E,W	Un:E,M,S,W	Un:M,W	Un:M,P,R,S,W	Un:M,P,R,S,W
DR	06-08	Un:E,M	Un:E,M,S,W		Un:E,W	Un:E	Un:E,M,S,W	Un:M,W	Un:M,P,S,W	Un:M,P,R,S,W
DR	06-09	Un:E,M	Un:E,M,S,W			Un:E	Un:E,M,S,W	Un:M,W	Un:M,P,S,W	Un:M,P,S,W
DR	06-10	Un:E,M	Un:E,M,S,W			Un:E,W	Un:E,M,S,W	Un:M,W	Un:M,P,S,W	Un:M,P,S,W
DR	06-11	Un:E,M	Un:E,M,S,W			Un:E,W	Un:E,M,S,W	Un:M,W	Un:M,P,R,S,W	Un:M,P,R,S,W
DR	06-12	Un:E,M	Un:E,M,S,W			Un:E,W	Un:E,M,S,W	Un:M,W	Un:M,P,S,W	Un:M,P,R,S,W
DR	06-13	Un:E,M	Un:E,M,S,W			Un:E,W	Un:E,M,S,W	Un:M,W	Un:M,P,S,W	Un:M,P,S,W
DR	06C01P3									
DR	06C02P2									
DR	06C03P2									
DR	06C04P2									
DR	06C06P2									
DR	06C08P2									

Site	Well	82-06	82-03	82-01	81-11
DR	06-01A				
DR	06-01B				
DR	06-01C				
DR	06-02		Un:M,P,S,W		Un:M,P,S,W
DR	06-03		Un:M,P,S,W		Un:M,P,S,W
DR	06-04		Un:M,P,R,S,W		Un:M,P,S,W
DR	06-05		Un:M,P,S,W		Un:M,P,S,W
DR	06-06		Un:M,P,R,S,W		Un:M,P,S,W
DR	06-07		Un:M,P,R,S,W	Un:R,W	Un:M,P,S,W
DR	06-08		Un:M,P,S,W		Un:M,P,S,W
DR	06-09		Un:M,P,S,W		Un:M,P,S,W
DR	06-10		Un:M,P,R,S,W		Un:M,P,S,W
DR	06-11		Un:M,P,R,S,W		Un:M,P,S,W
DR	06-12		Un:M,P,R,S,W		Un:M,P,S,W
DR	06-13	Un:M,P,S,W	Un:M,P,S,W	Un:R,W	Un:M,P,R,S,W
DR	06C01P3				
DR	06C02P2				
DR	06C03P2				
DR	06C04P2				
DR	06C06P2				
DR	06C08P2				

TABLE 5-1
ABG - PROPOSED SAMPLING FOR SOIL
PAGE 1 OF 2

Proposed Location[A]	Parameters[B]	Rationale
		ABG Proper
Surface Soil		
1990 Boring 4	MSVP	High inorganics; complete analytical suites
1990 Boring 7	MSVP	High inorganics; complete analytical suites
1990 Boring 12	M	High inorganics
1993 Boring 1	MSVP	Background; complete analytical suites
1993 Boring 2	MP	Background
1993 Boring 3	MSVP	Background; complete analytical suites
1993 Boring 5	M	Low/no contamination
1993 Boring 6	M	Areal coverage
1993 Boring 7	MSVP	Low/no contamination; complete analytical suites
1993 Boring 13	M	Areal coverage
1993 Boring 14	MSVP	Low/No contamination; complete analytical suites
1993 Boring 17	M,V	Highest TCE
1993 Boring 19	M	Areal coverage
1993 Boring 22	M	High inorganics
1993 Boring 25	M	Areal coverage
1993 Boring 31	M	High inorganics
1993 Boring 33	M	Low/no contamination
1993 Boring 37	M	Low/no contamination

TABLE 5-1
ABG - PROPOSED SAMPLING FOR SOIL
PAGE 2 OF 2

Proposed Location[A]	Parameters[B]	Rationale
Surface Soil (cont'd)		
1993 Surface 40	M	High inorganics
1993 Surface 49	M	High inorganics
1993 Surface 61	M	High inorganics
Subsurface Soil		
1990 Boring 4 (3-3.5 ft; 5.5-6.5 ft)	MSVP	High inorganics; complete analytical suites
1990 Boring 12 (2.5-3 ft)	M	High inorganics
1993 Boring 22 (2.5-4.5 ft; 4.5-7 ft)	M	High inorganics
	Jeep Trail	
None	None	Database complete

[A] Sample locations are shown in Figure 4-1.
[B] Parameters:

M = Inorganics
S = Semivolatile organics
V = Volatile organics
P = Pesticides

TABLE 5-2
ABG - PROPOSED SAMPLING FOR SEDIMENT AND SURFACE WATER

Proposed Location[A]	Parameters[B]	Rationale
		ABG
ABG 8	EMSVP	Most explosives hits; full analytical suites
ABG 11	EMSVP	High metals; full analytical suites
ABG 5	EM	High metals
ABG 6	EMP	High metals, explosives

[A] Sample locations shown in Figure 4-3.
[B] Parameters:

E = Explosives; sediment analysis only
M = Inorganics
S = Semivolatile organics
V = Volatile organics
P = Pesticides

TABLE 5-3
ABG - PROPOSED SAMPLING FOR GROUNDWATER

Monitoring Well[A]	Parameters[B]	Rationale
A. Beaver Bend Aquifer		
03C01	E,V	Past hits of RDX, TNT
B. Beech Creek/Big Clifty Aquifer		
03C15	E	TNT hit
03-16	E	Hits of RDX
03-21	E,M,S,V,P	Hits of RDX, HMX; complete analytical suites
03-13	E	Hits of RDX, HMX
03C20	E,V	Hits of explosives, volatiles
C. Golconda Aquifer		
03C23	M	Hits of barium
03C08AP3	E,M,P,S,V	No contamination; complete analytical suites
D. Alluvial Aquifer		
03B05	E,M	Hits of metals
03B07	E,M	Hits of RDX

[A] Well locations shown in Figure 4-5 (Beaver Bend), 4-6 and 4-7 (Beech Creek/Big Clifty), 4-10 (Golconda), and 4-11 (alluvium).
[B] Parameters:

E = Explosives
M = Inorganics
S = Semivolatile organics
V = Volatile organics
P = Pesticides

TABLE 5-4
ORR - PROPOSED SAMPLING FOR SOIL

Proposed Location[A]	Parameters[B]	Rationale
Surface Soil		
1990 Boring 1	MSVP	No contamination; complete analytical suites
1990 Boring 5	M	Moderate contamination (explosives)
1990 Boring 9	MP	High inorganics
1990 Boring 12	M	Moderate contamination (inorganics)
Subsurface Soil		
1990 Boring 5 (3-3.5 ft)	M	Moderate contamination (explosives); high inorganics
1990 Boring 12 (3-3.5 ft)	M	Moderate contamination (inorganics)

[A] Sample locations shown in Figure 4-13.
[B] Parameters:

M = Inorganics
S = Semivolatile organics
V = Volatile organics
P = Pesticides

TABLE 5-5
ORR/DR - PROPOSED SAMPLING FOR SURFACE WATER AND SEDIMENT

Location	Sample Type	Parameters	Rationale
Turkey Creek	Surface Water	None	Database complete.
Turkey Creek	Sediment	None	Database complete.
Boggs Creek	Surface Water	None	Database complete.
Boggs Creek	Sediment	None	Database complete.

TABLE 5-6
ORR - PROPOSED SAMPLING FOR GROUNDWATER

Monitoring Well[A]	Parameters[B]	Rationale
A. Beech Creek Aquifer		
06C09	M	Hits of zinc
B. Golconda Aquifer		
06-21	M	No data available
06C16P3	M	Metal contamination
C. Surficial Aquifer		
None	None	Database complete

[A] Sample locations shown in Figures 4-15 (Beech Creek) and 4-16 (Golconda).
[B] Parameters:

M = Inorganics

TABLE 5-7
DR - PROPOSED SAMPLING FOR SOIL

Location	Parameters	Rationale
Demolition Range	None	Database Complete

TABLE 5-8
DR - PROPOSED SAMPLING FOR GROUNDWATER

Monitoring Well	Parameters	Rationale
A. Beech Creek Aquifer		
None	None	Database complete
B. Intermediate Zone		
None	None	Dry well
C. Surficial Zone		
None	None	Database complete

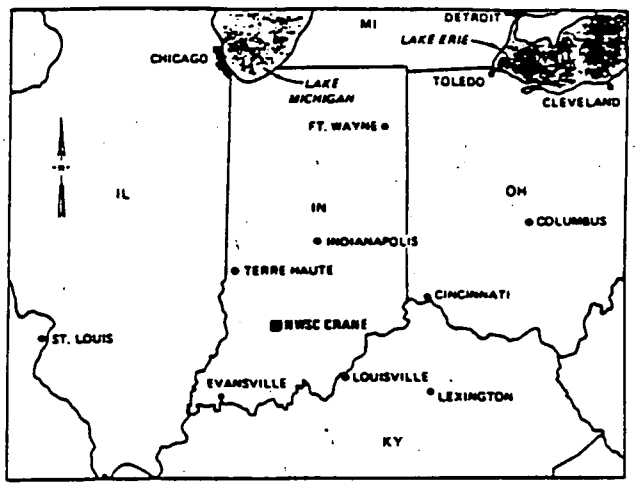
TABLE 5-9
ABG/ORR/DR - PROPOSED BACKGROUND GROUNDWATER SAMPLING

Monitoring Well[A]	Parameters[B]	Rationale
		ABG Proper
03C19P3	E,M,V,S,P	Golconda aquifer background well
		ORR
None	None	Database complete
		DR
None	None	Database complete

[A] Sample location shown in Figure 4-10.
[B] Parameters:

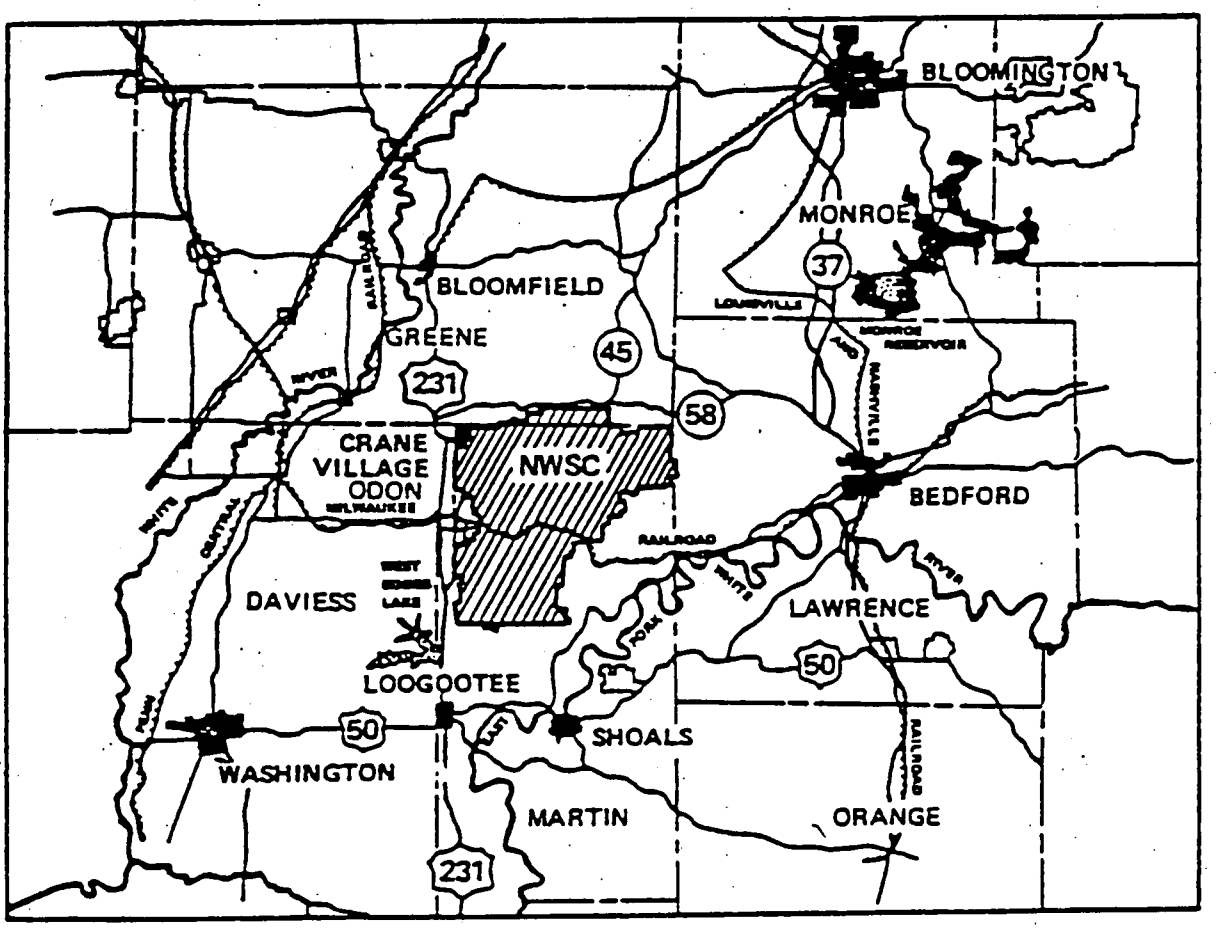
E = Explosives
M = Inorganics
S = Semivolatile organics
V = Volatile organics
P = Pesticides

FIGURES



N

NO SCALE



SOURCES: CHESAPEAKE DIVISION, NAVAL FACILITIES ENGINEERING COMMAND, 1979 AND NAVAL ENERGY AND ENVIRONMENTAL SUPPORT AGENCY, 1983.

DATE

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RUST

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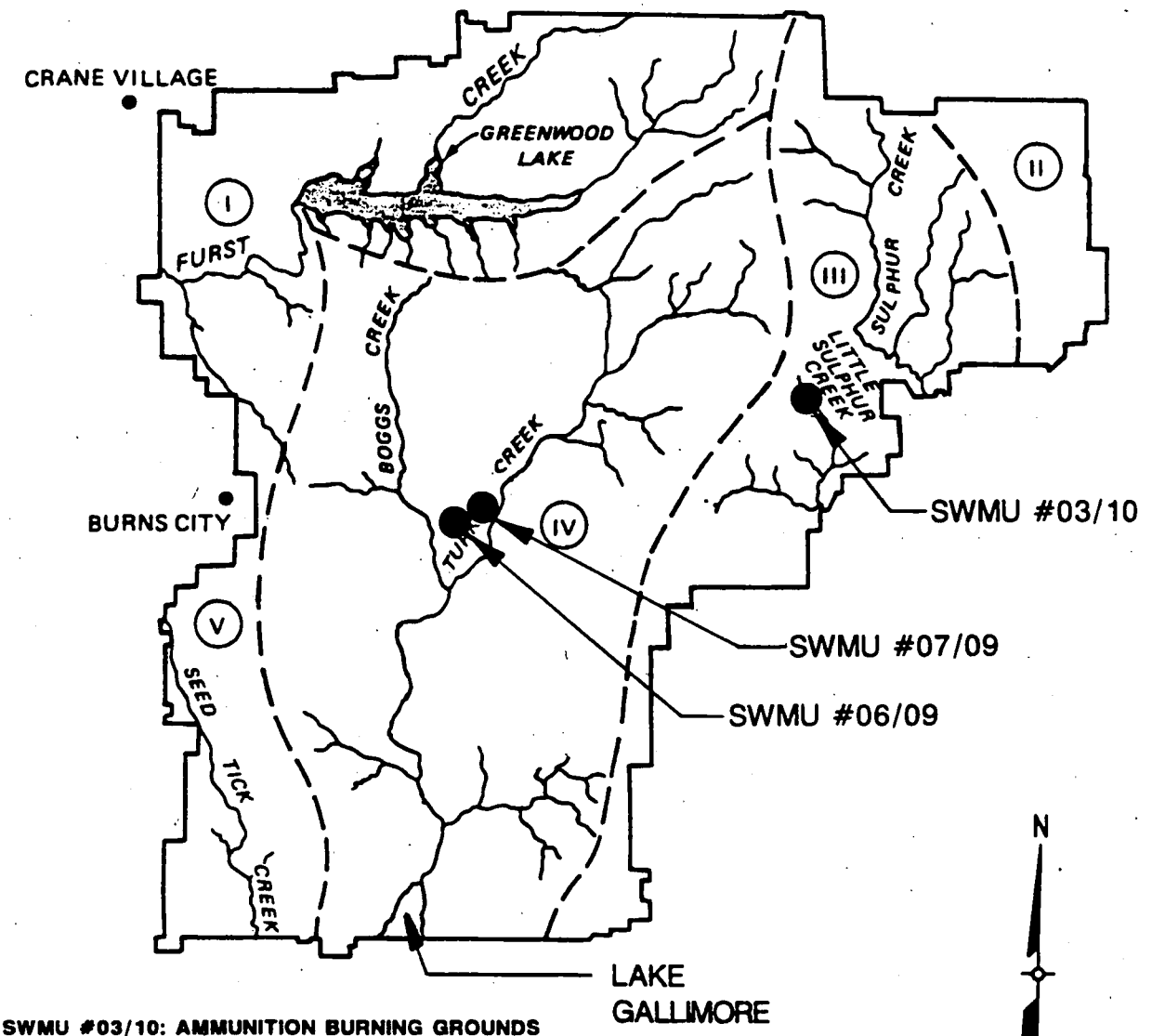
FIGURE 2-1
GENERAL LOCATION MAP

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626



SWMU #03/10: AMMUNITION BURNING GROUNDS
SWMU #06/09: DEMOLITION RANGE
SWMU #07/09: OLD RIFLE RANGE

SOURCE: CHESAPEAKE DIVISION NAVAL FACILITIES COMMAND, 1979

SCALE

2 0 2 4 MI

DATE

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RUST

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FIGURE 2-2
SWMU LOCATIONS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

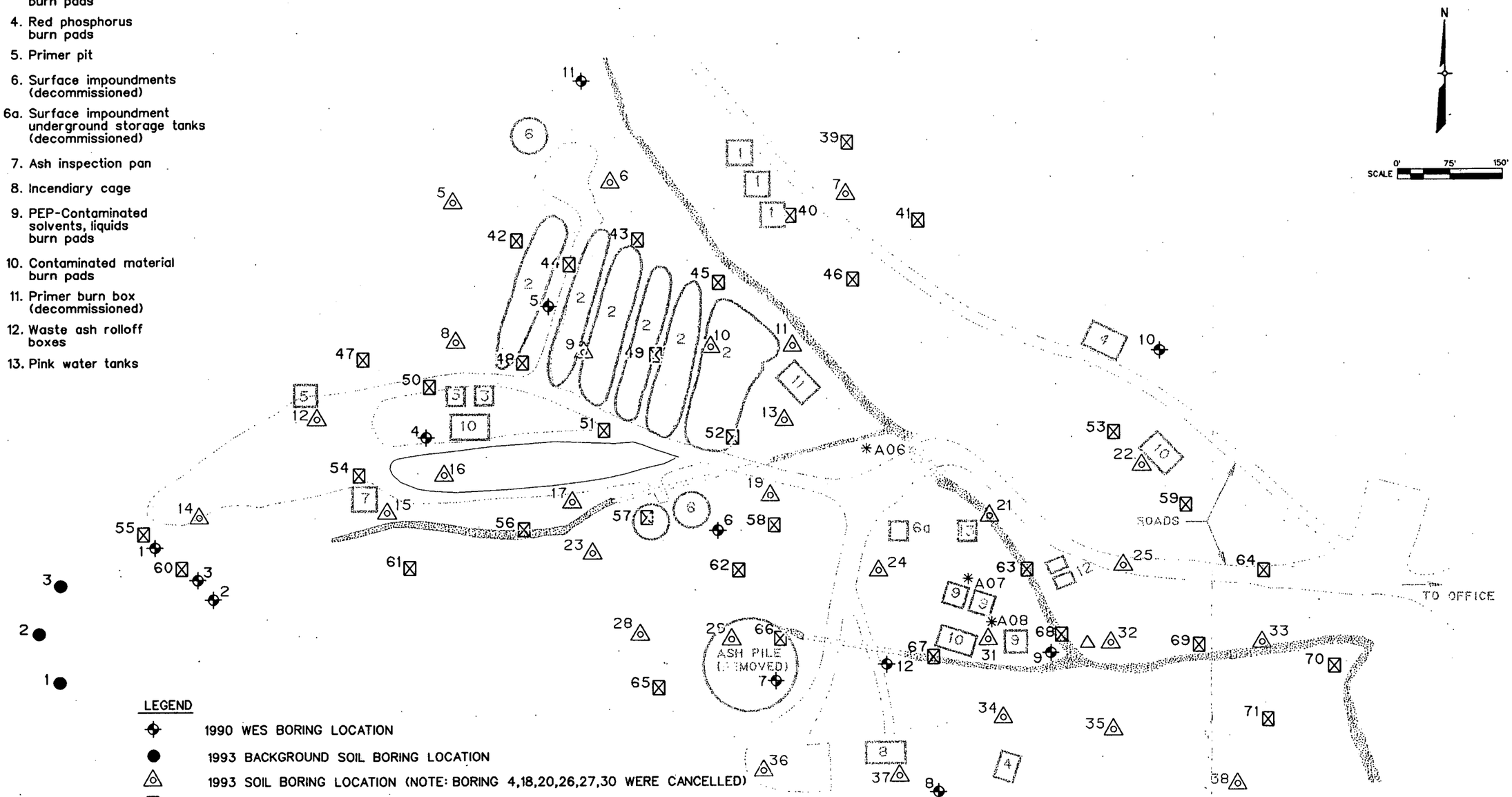
20626

TREATMENT UNIT LEGEND

1. Sludge burn pans and asociated tanks
2. Burn pans
3. Production scrap burn pads
4. Red phosphorus burn pads
5. Primer pit
6. Surface impoundments (decommissioned)

6a. Surface impoundment underground storage tanks (decommissioned)

7. Ash inspection pan
8. Incendiary cage
9. PEP-Contaminated solvents, liquids burn pads
10. Contaminated material burn pads
11. Primer burn box (decommissioned)
12. Waste ash rolloff boxes
13. Pink water tanks



LEGEND

- 1990 WES BORING LOCATION
- 1993 BACKGROUND SOIL BORING LOCATION
- 1993 SOIL BORING LOCATION (NOTE: BORING 4,18,20,26,27,30 WERE CANCELLED)
- 1993 SURFACE SOIL SAMPLE LOCATION (GRAB SAMPLES)
- LITTLE SULFUR CREEK
- 1995 SURFACE SOIL SAMPLE LOCATION

RUST

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FIGURE 4-1
AMMUNITION BURNING GROUND SOIL SAMPLING LOCATIONS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

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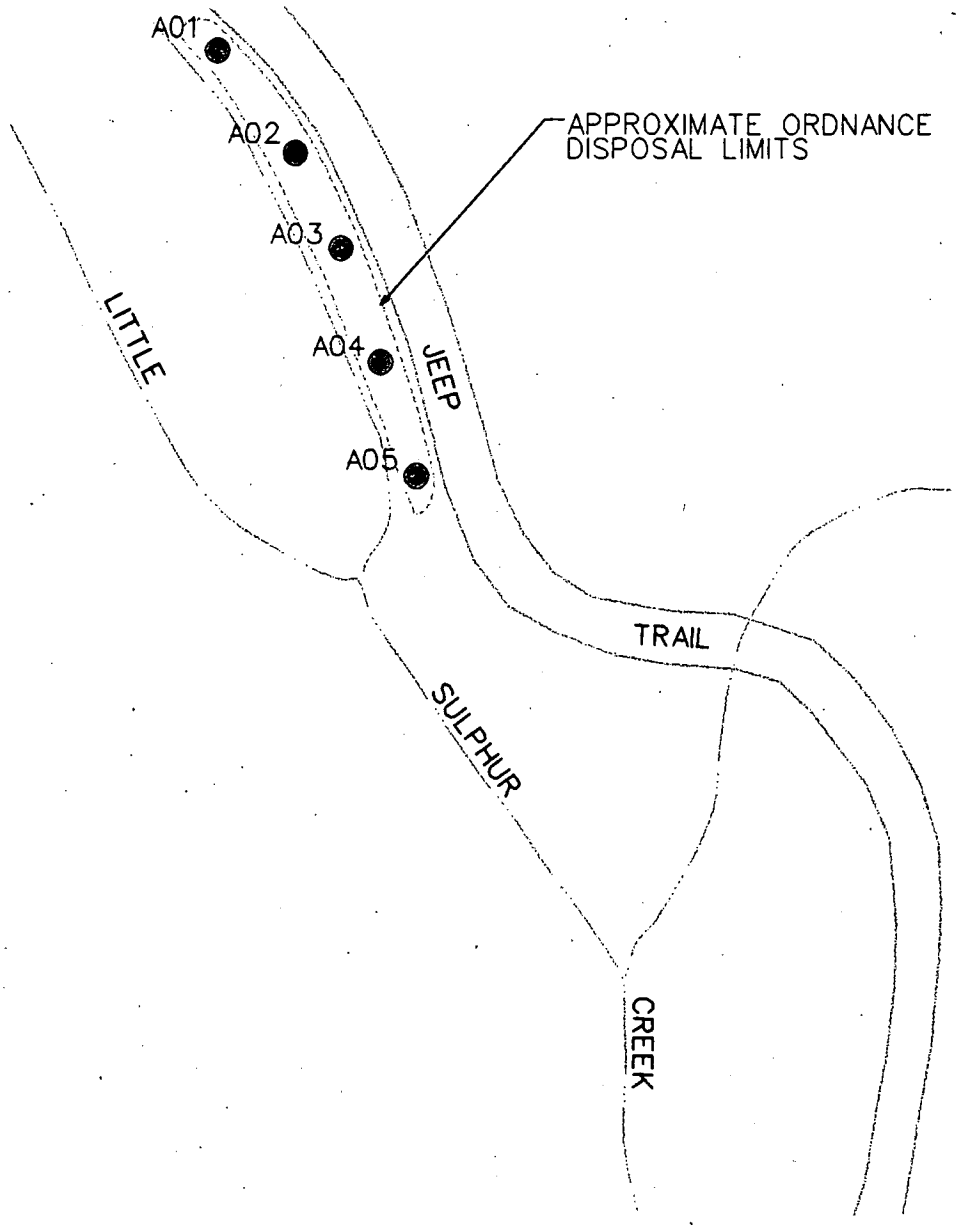
DGN DGN F:/132232/CRANE5.DGN DATE



LEGEND

● SURFACE SOIL SAMPLING LOCATION

N

SCALE 0' 25' 50' 100'

DATE

DGN/132232/JEEP2.DGN

RUST

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FIGURE 4-2
JEEP TRAIL
SOIL SAMPLING LOCATIONS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

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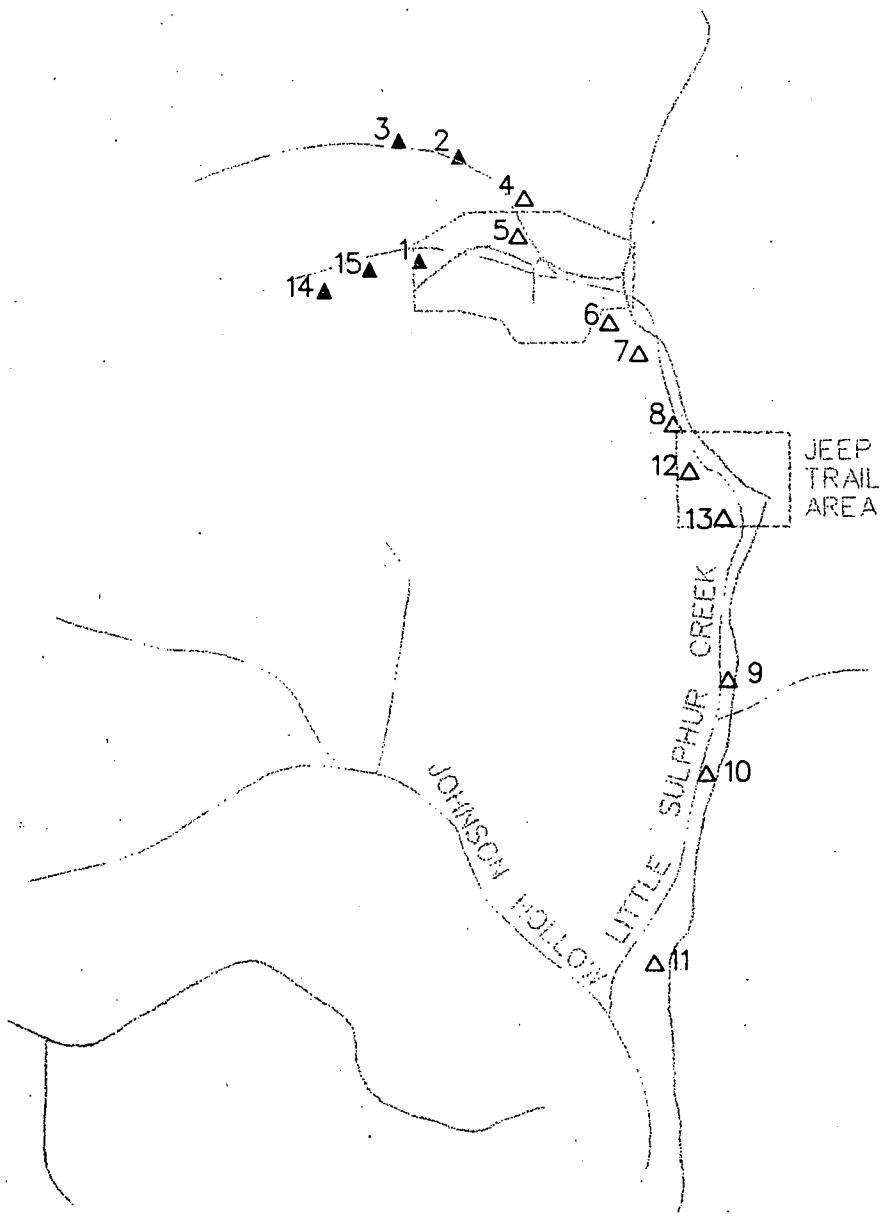

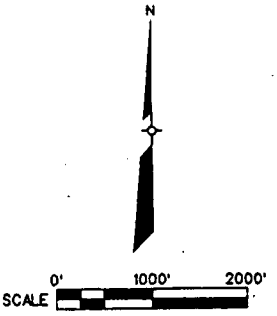

LEGEND

▲ UPSTREAM SURFACE WATER/SEDIMENT SAMPLE

△ DOWNSTREAM SURFACE WATER/SEDIMENT SAMPLE

RUST

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FIGURE 4-3
AMMUNITION BURNING GROUND
SURFACE WATER/SEDIMENT
SAMPLING LOCATIONS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

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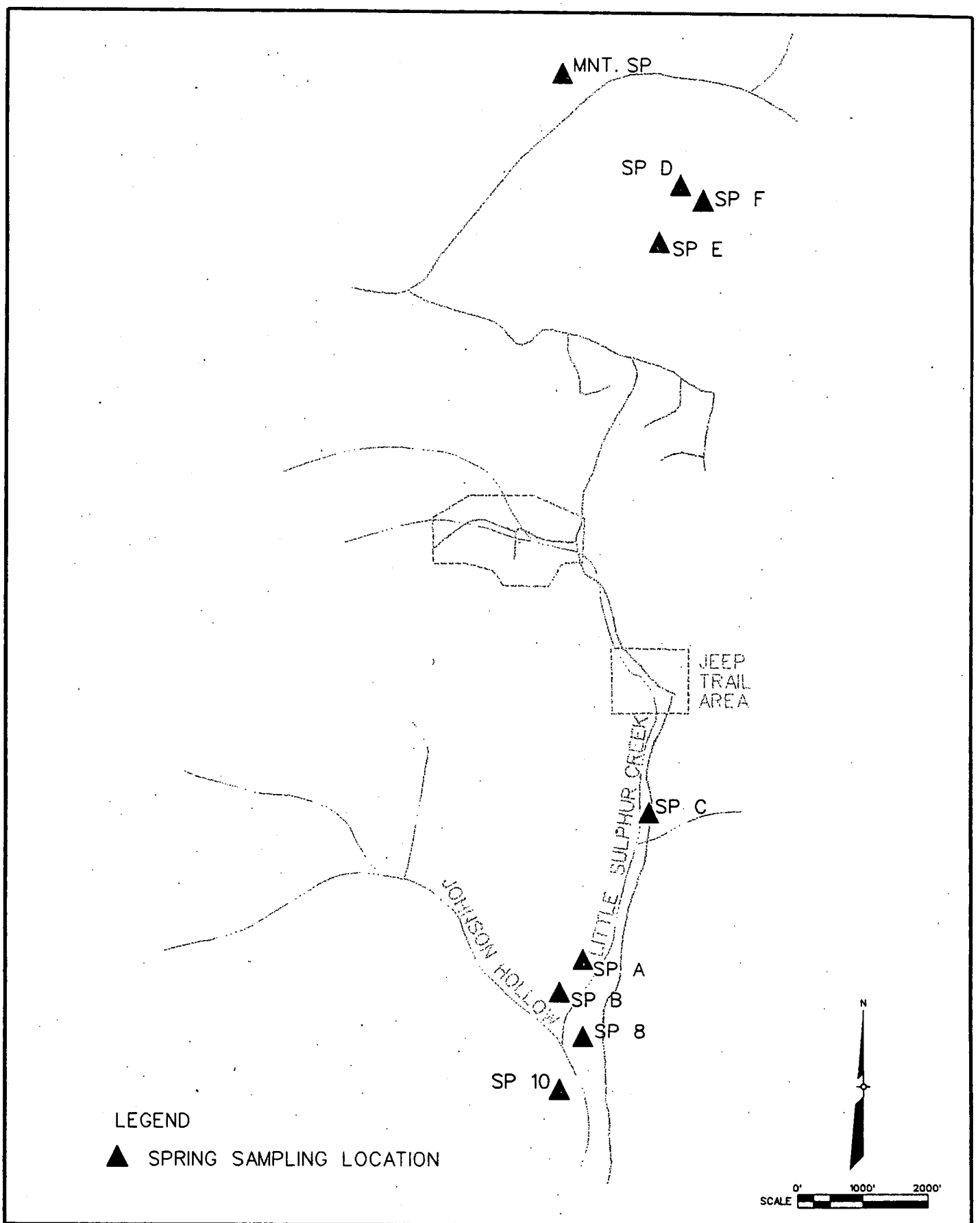
DATE

DGN F:/ 132232/AMMO6.DGN



DATE

DGN F:/132232/AMMO7.DGN

RUST

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FIGURE 4-4

AMMUNITION BURNING GROUND
SPRING SAMPLING LOCATION

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

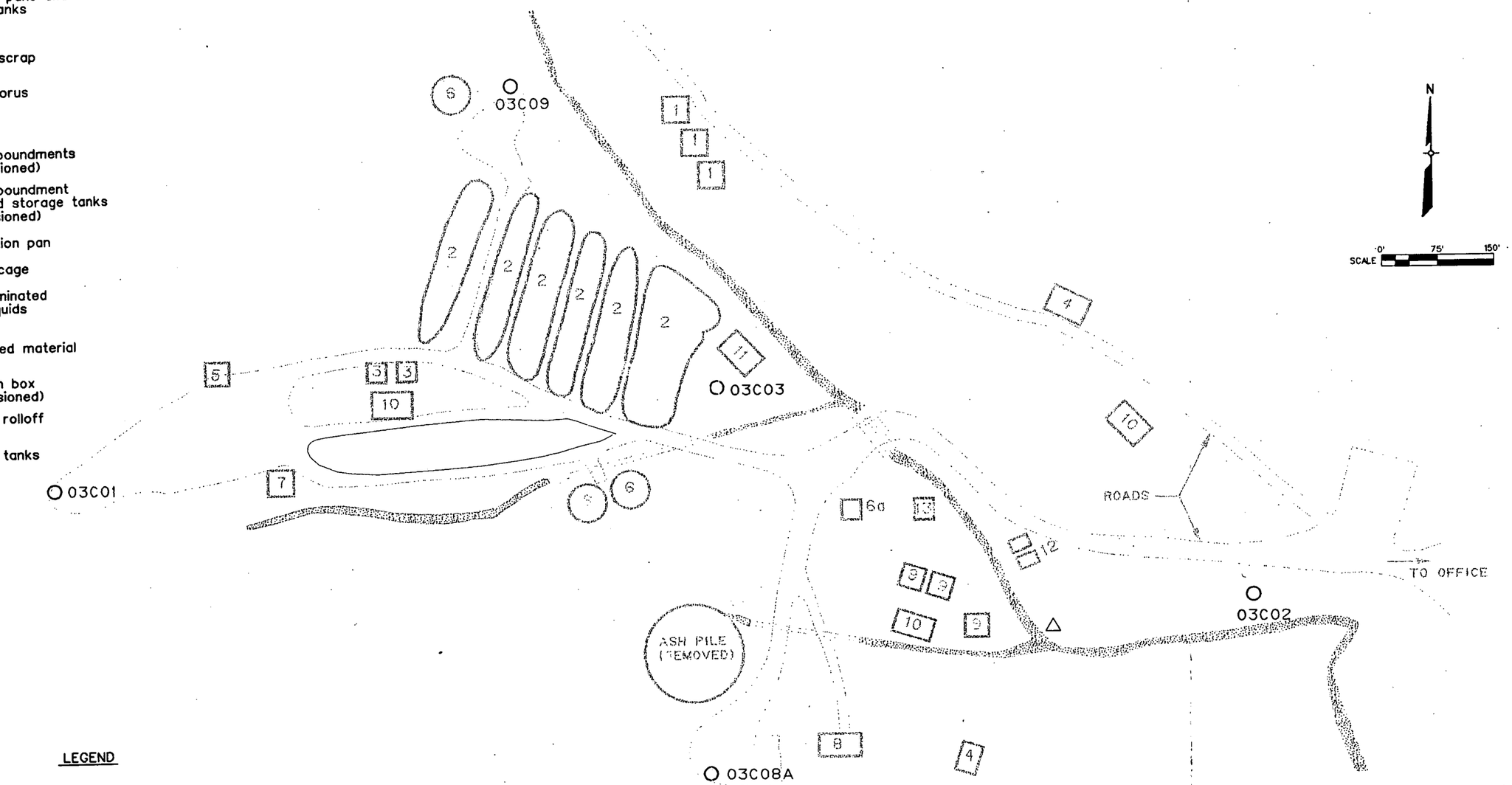
20626

TREATMENT UNIT LEGEND

1. Sludge burn pans and asociated tanks
2. Burn pans
3. Production scrap burn pads
4. Red phosphorus burn pads
5. Primer pit
6. Surface impoundments (decommissioned)

6a. Surface impoundment underground storage tanks (decommissioned)

7. Ash inspection pan
8. Incendiary cage
9. PEP-Contaminated solvents, liquids burn pads
10. Contaminated material burn pads
11. Primer burn box (decommissioned)
12. Waste ash rolloff boxes
13. Pink water tanks



LEGEND

EXISTING MONITORING WELL

LITTLE SULFUR CREEK

RUST

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FIGURE 4-5
AMMUNITION BURNING GROUND
BEAVER BEND AQUIFER WELLS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626

DATE

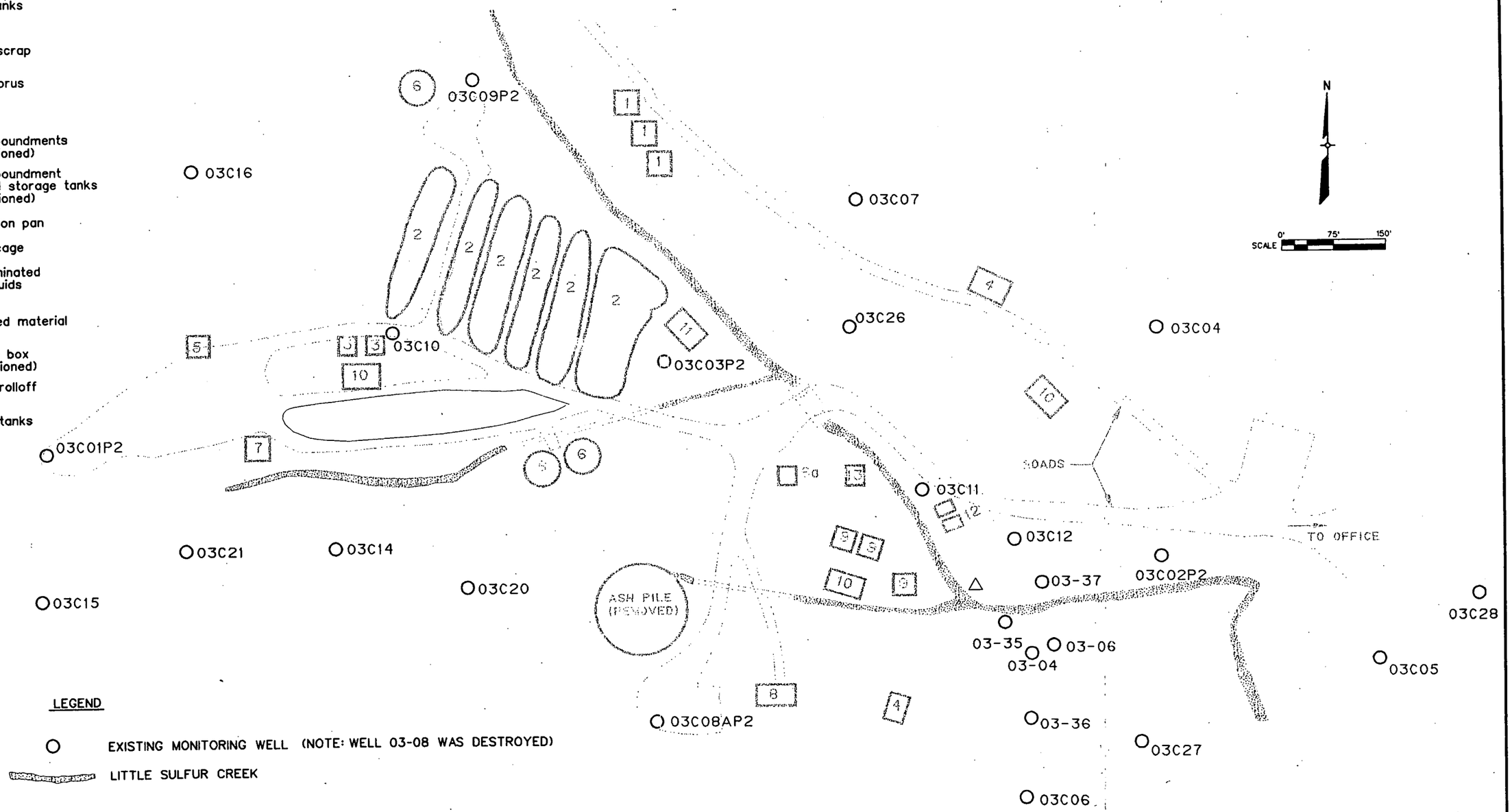
DGN F:/132232/CRANEA1.DGN

TREATMENT UNIT LEGEND

1. Sludge burn pans and asociated tanks
2. Burn pans
3. Production scrap burn pads
4. Red phosphorus burn pads
5. Primer pit
6. Surface impoundments (decommissioned)

6a. Surface impoundment underground storage tanks (decommissioned)

7. Ash inspection pan
8. Incendiary cage
9. PEP-Contaminated solvents, liquids burn pads
10. Contaminated material burn pads
11. Primer burn box (decommissioned)
12. Waste ash rolloff boxes
13. Pink water tanks



RUST

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FIGURE 4-6
AMMUNITION BURNING GROUND
ON-SWMU BEECH CREEK AQUIFER WELLS

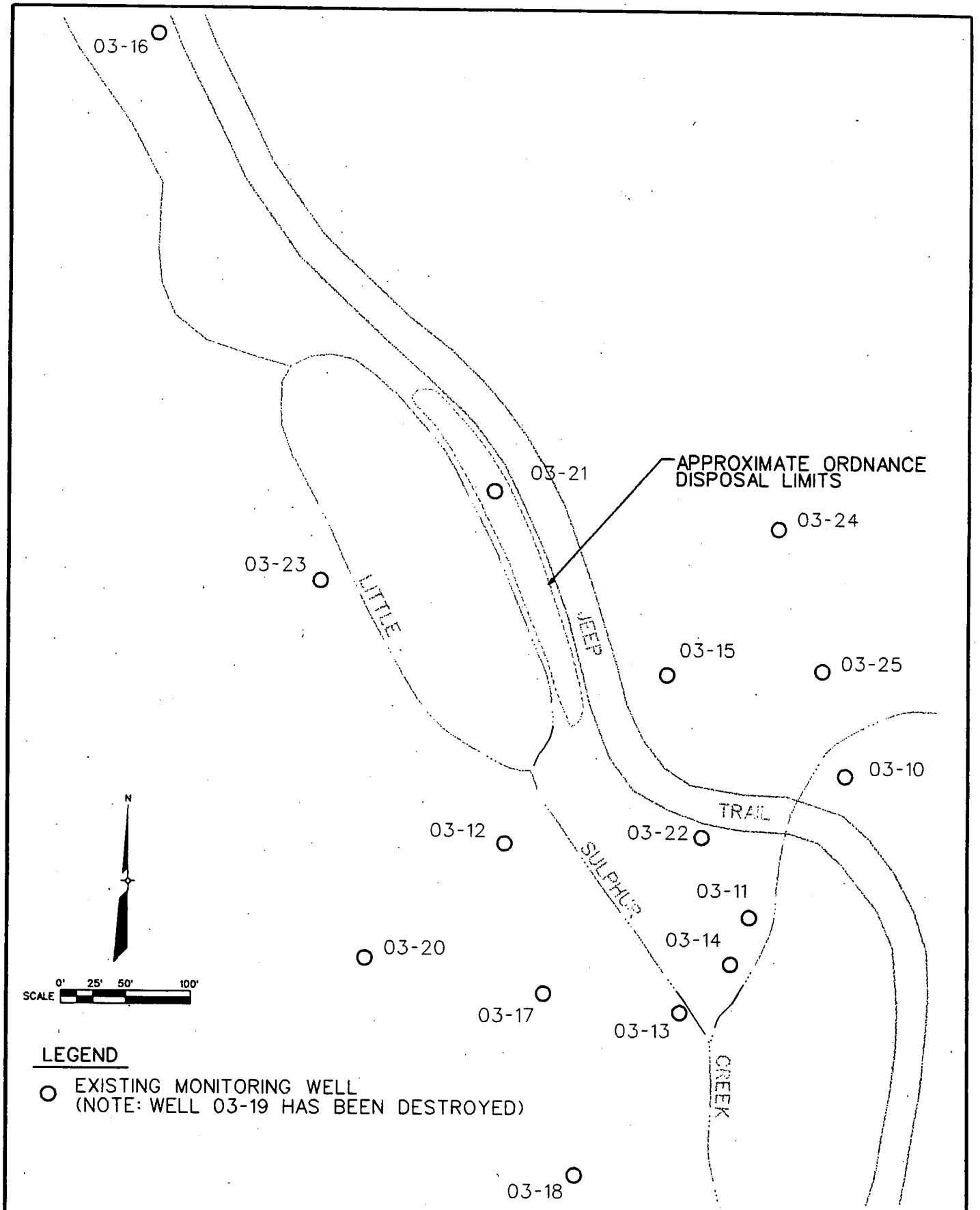
NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626

DATE

DGN F:/132232/CRANEA2.DGN



DATE

DGN F:/132232/JEEP.DGN

RUST

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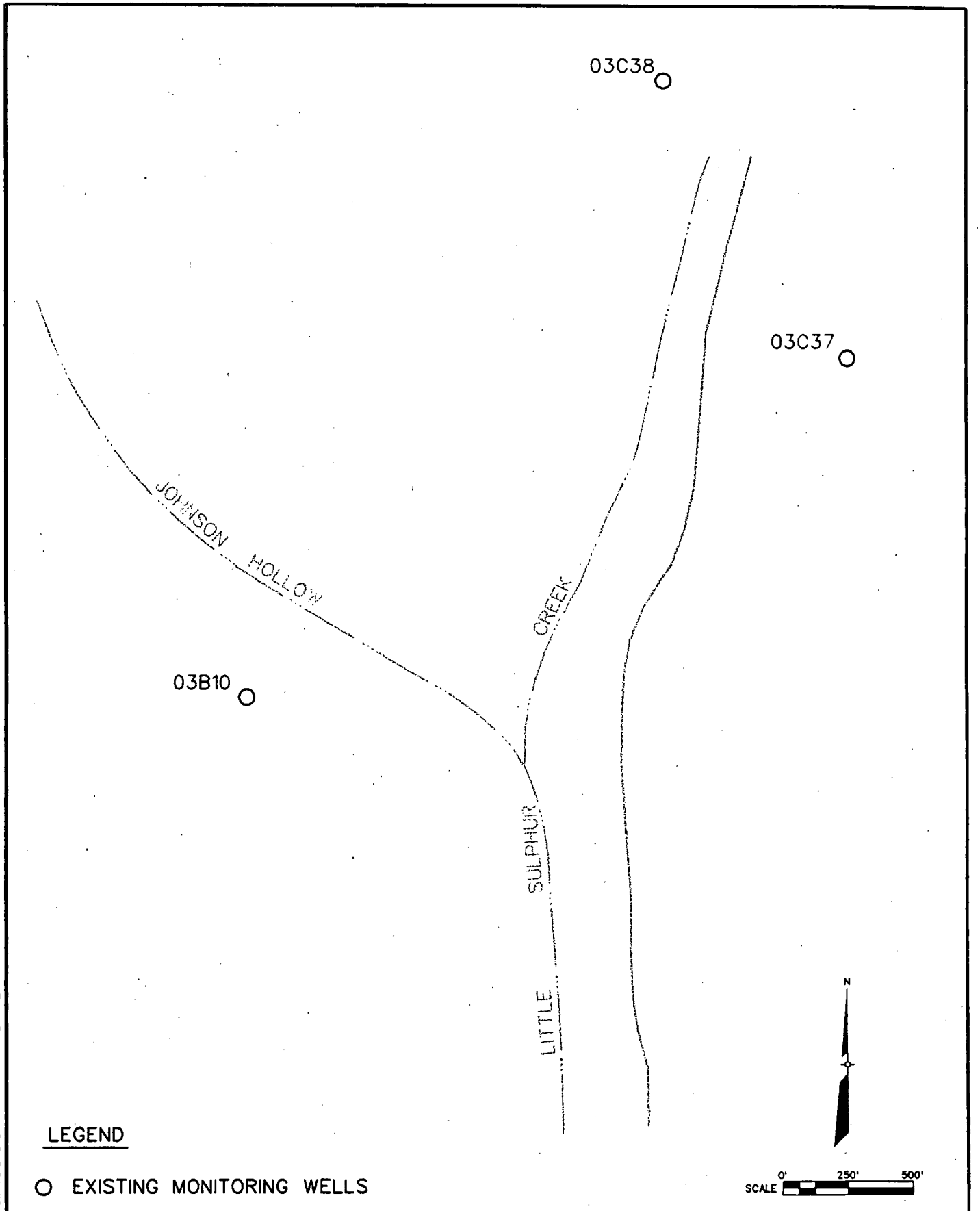
FIGURE 4-7

JEEP TRAIL
ON-SWMU BEECH CREEK AQUIFER WELLS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626



DATE

DGN F:/132232/AMMO5.DGN

RUST

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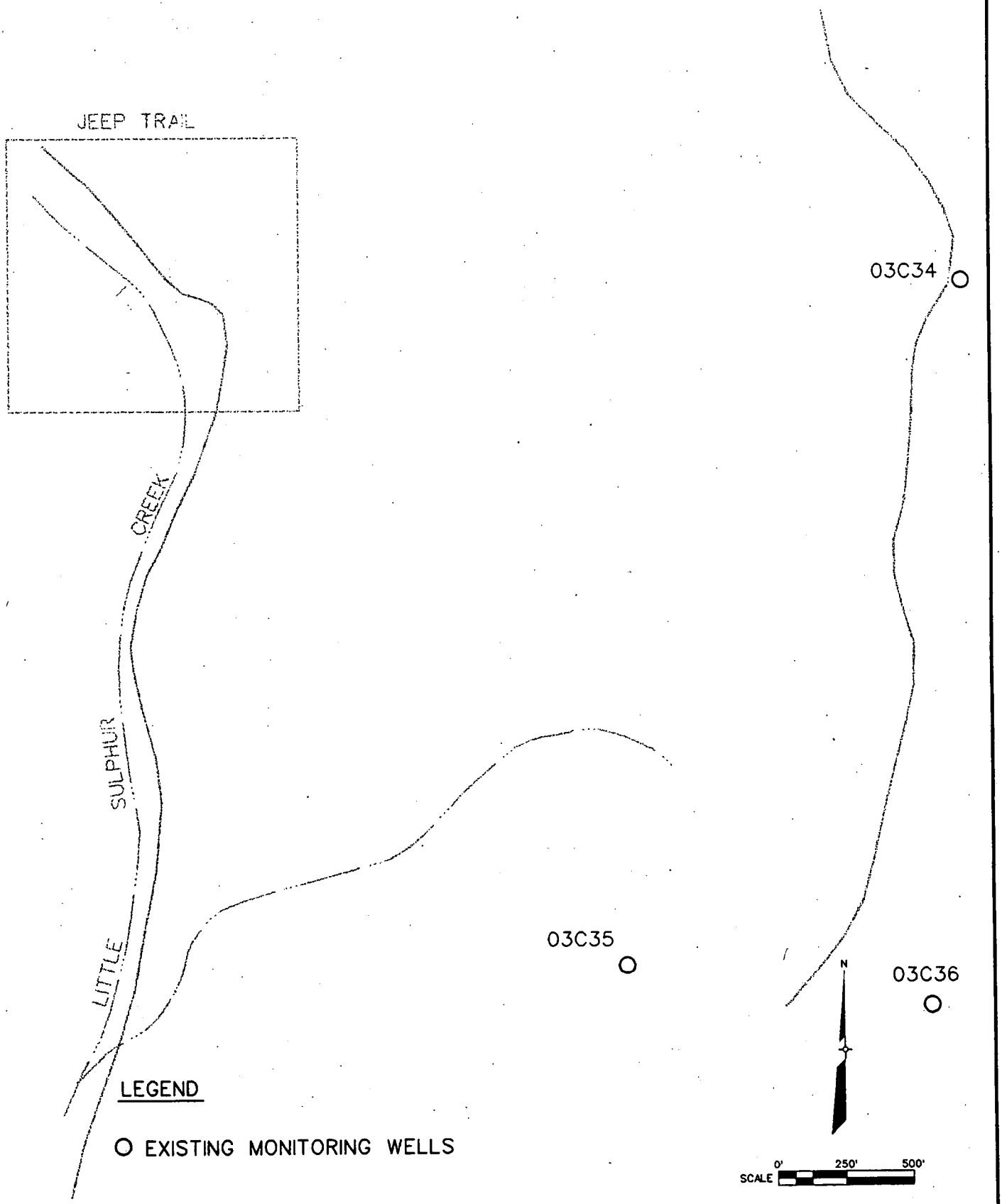
FIGURE 4-8A
JEEP TRAIL
OFF-SWMU BEECH CREEK
AQUIFER WELLS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626



DATE

DGN/F: 132232/AMMO3.DGN

RUST

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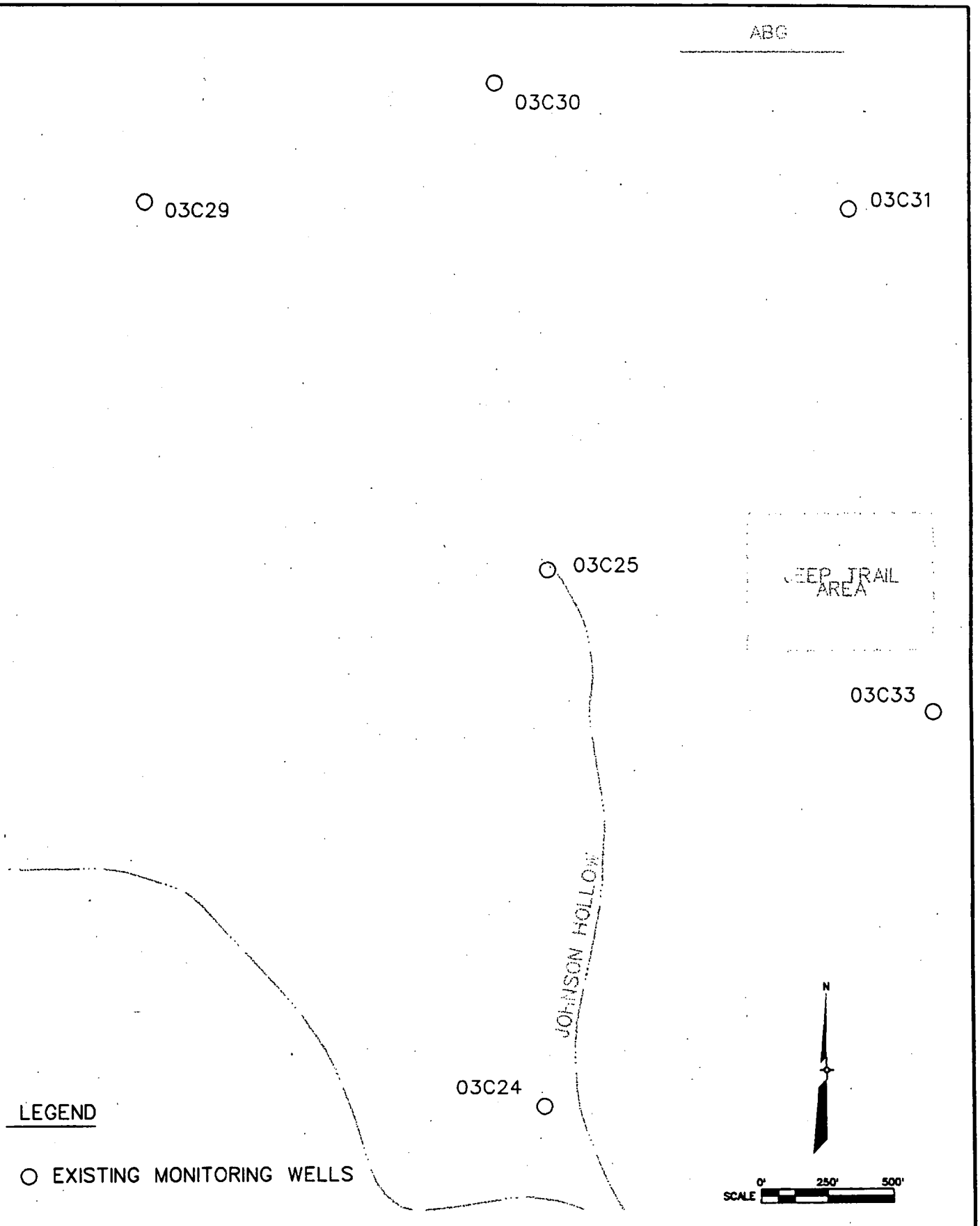
FIGURE 4-8B
AMMUNITION BURNING GROUND
OFF-SWMU BEECH CREEK AQUIFER WELLS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626



DATE

DGN/132232/AMMO1.DGN

RUST

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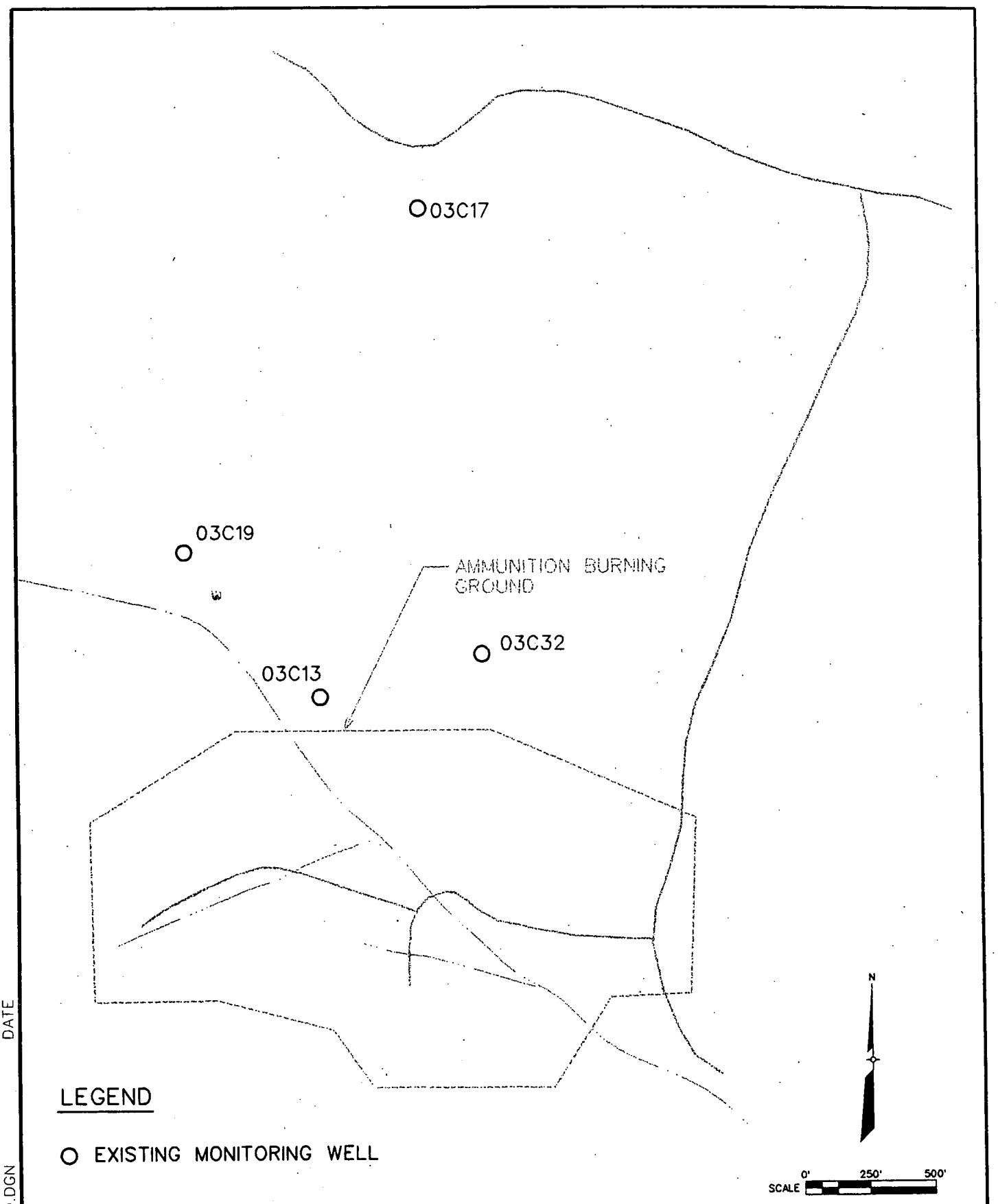
FIGURE 4-8C
AMMUNITION BURNING GROUND
OFF-SWMU BEECH CREEK
AQUIFER WELLS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626



DATE

DGN/132232/AMMO.DGN

RUST

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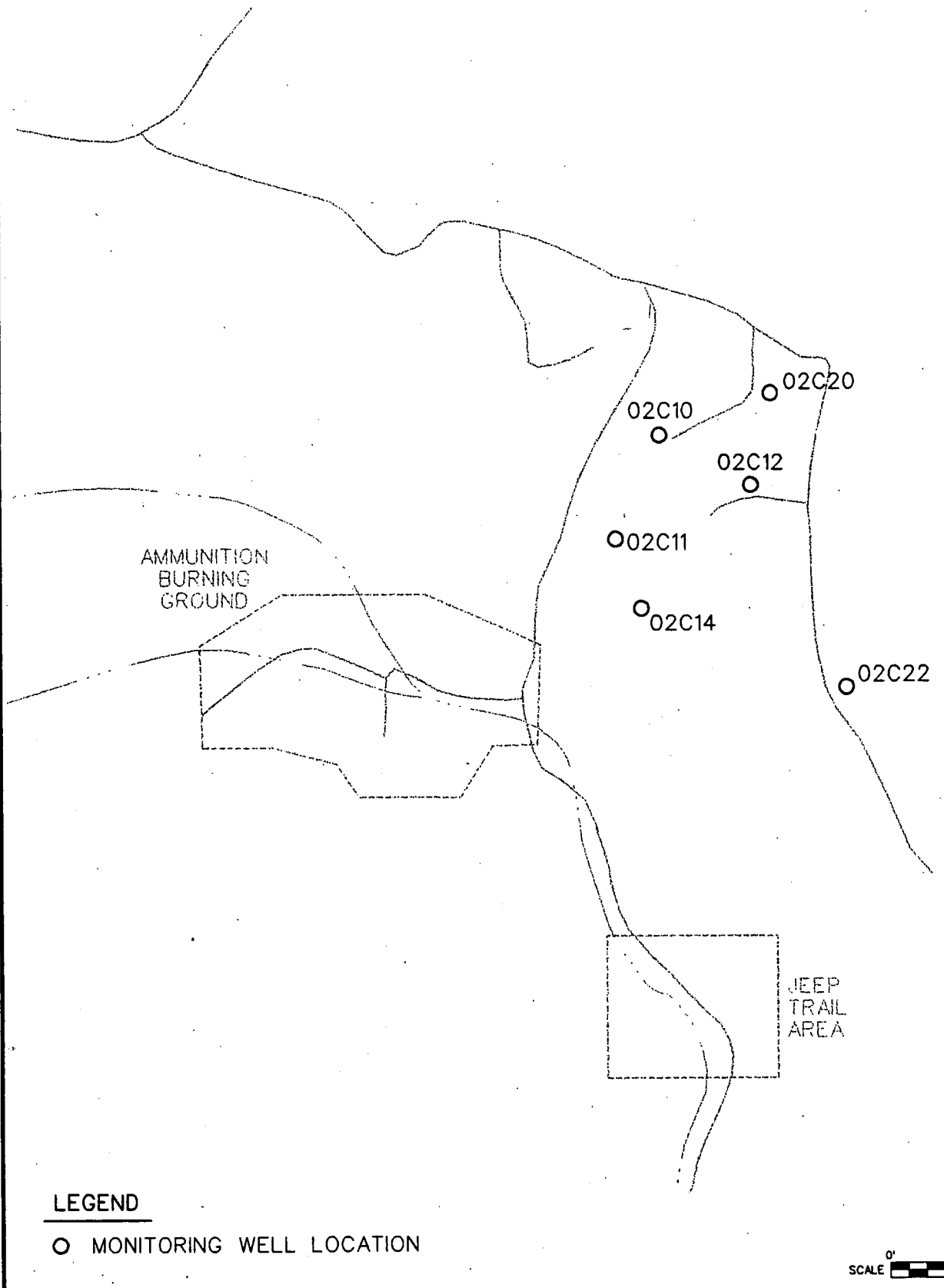
FIGURE 4-8D
AMMUNITION BURNING GROUND
OFF-SWMU BEECH CREEK AQUIFER WELLS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626



LEGEND

O MONITORING WELL LOCATION

DATE

DGN/132232/AMMO8.DGN

RUST

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FIGURE4-8E

AMMUNITION BURNING GROUND
OFF-SWMU BEECH CREEK AQUIFER WELLS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

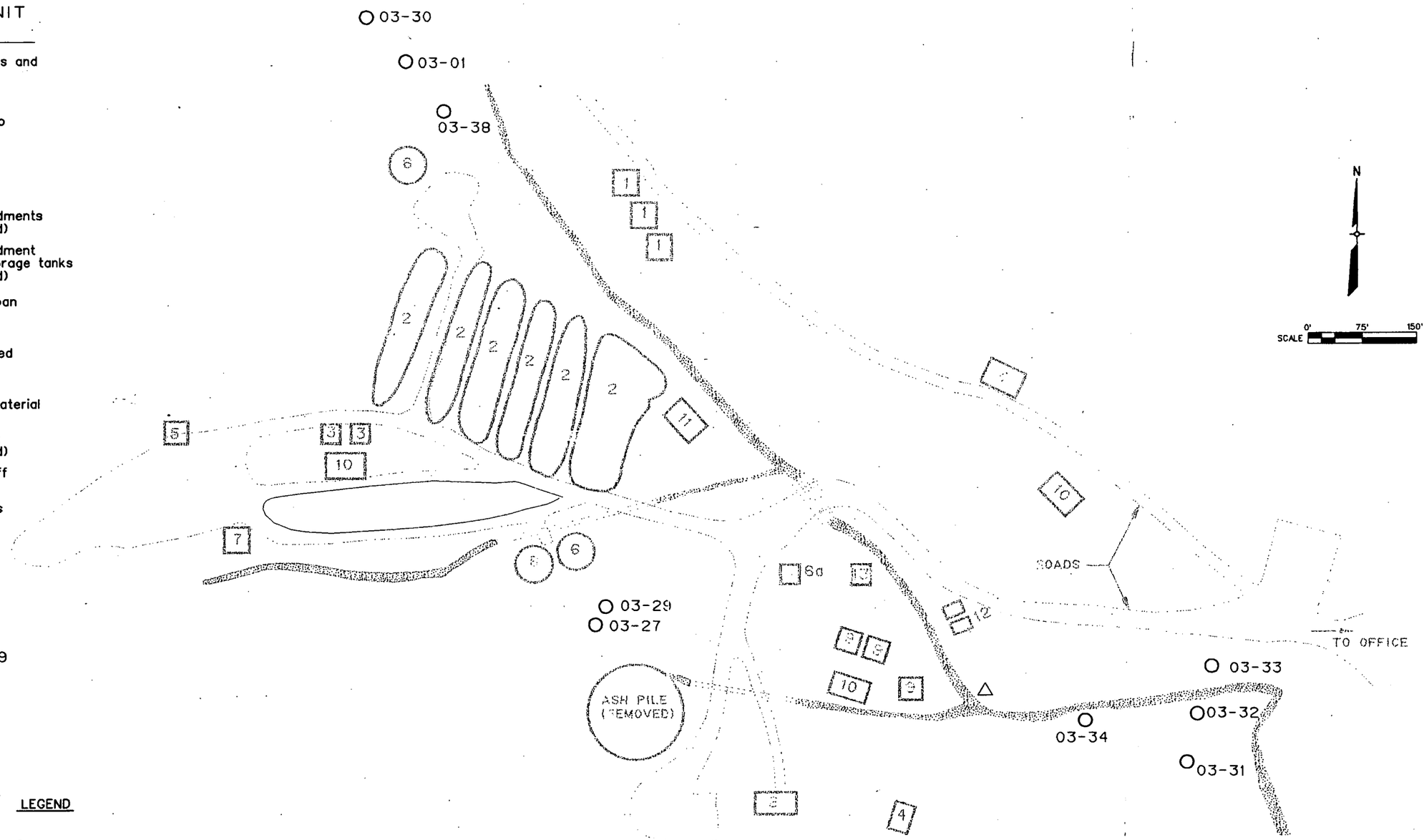
20626

TREATMENT UNIT LEGEND

1. Sludge burn pans and asociated tanks
2. Burn pans
3. Production scrap burn pads
4. Red phosphorus burn pads
5. Primer pit
6. Surface impoundments (decommissioned)

6a. Surface impoundment underground storage tanks (decommissioned)

7. Ash inspection pan
8. Incendiary cage
9. PEP-Contaminated solvents, liquids burn pads
10. Contaminated material burn pads
11. Primer burn box (decommissioned)
12. Waste ash rolloff boxes
13. Pink water tanks



LEGEND

EXISTING MONITORING WELL

LITTLE SULFUR CREEK

RUST

Rust Environment & Infrastructure Inc.

FIGURE 4-9

AMMUNITION BURNING GROUND
BIG CLIFTY AQUIFER WELLS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626

DGN F:/132232/CRANE3.DGN

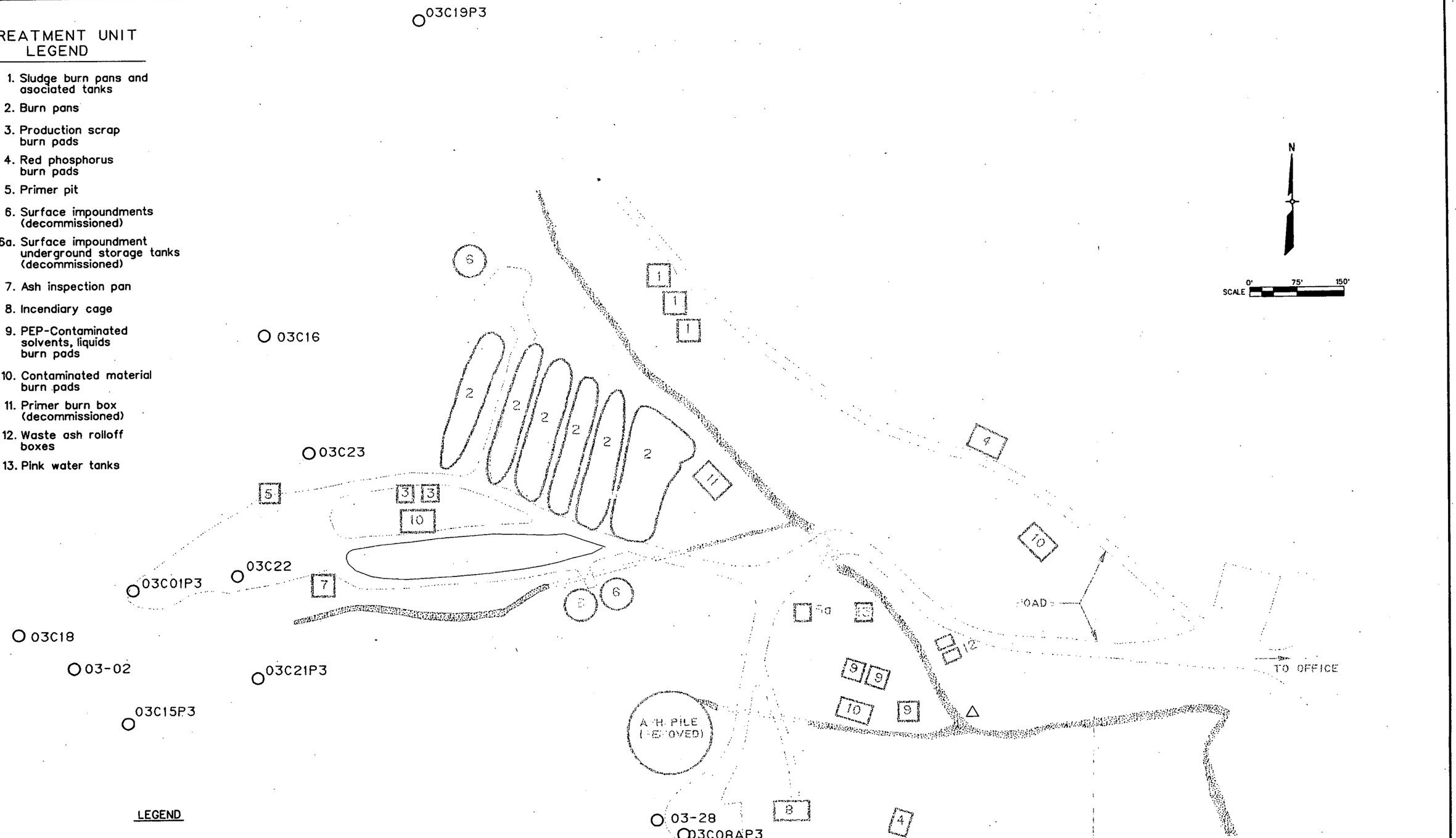
DATE

TREATMENT UNIT LEGEND

1. Sludge burn pans and asociated tanks
2. Burn pans
3. Production scrap burn pads
4. Red phosphorus burn pads
5. Primer pit
6. Surface impoundments (decommissioned)

6a. Surface impoundment underground storage tanks (decommissioned)

7. Ash inspection pan
8. Incendiary cage
9. PEP-Contaminated solvents, liquids burn pads
10. Contaminated material burn pads
11. Primer burn box (decommissioned)
12. Waste ash rolloff boxes
13. Pink water tanks



RUST

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FIGURE 4-10

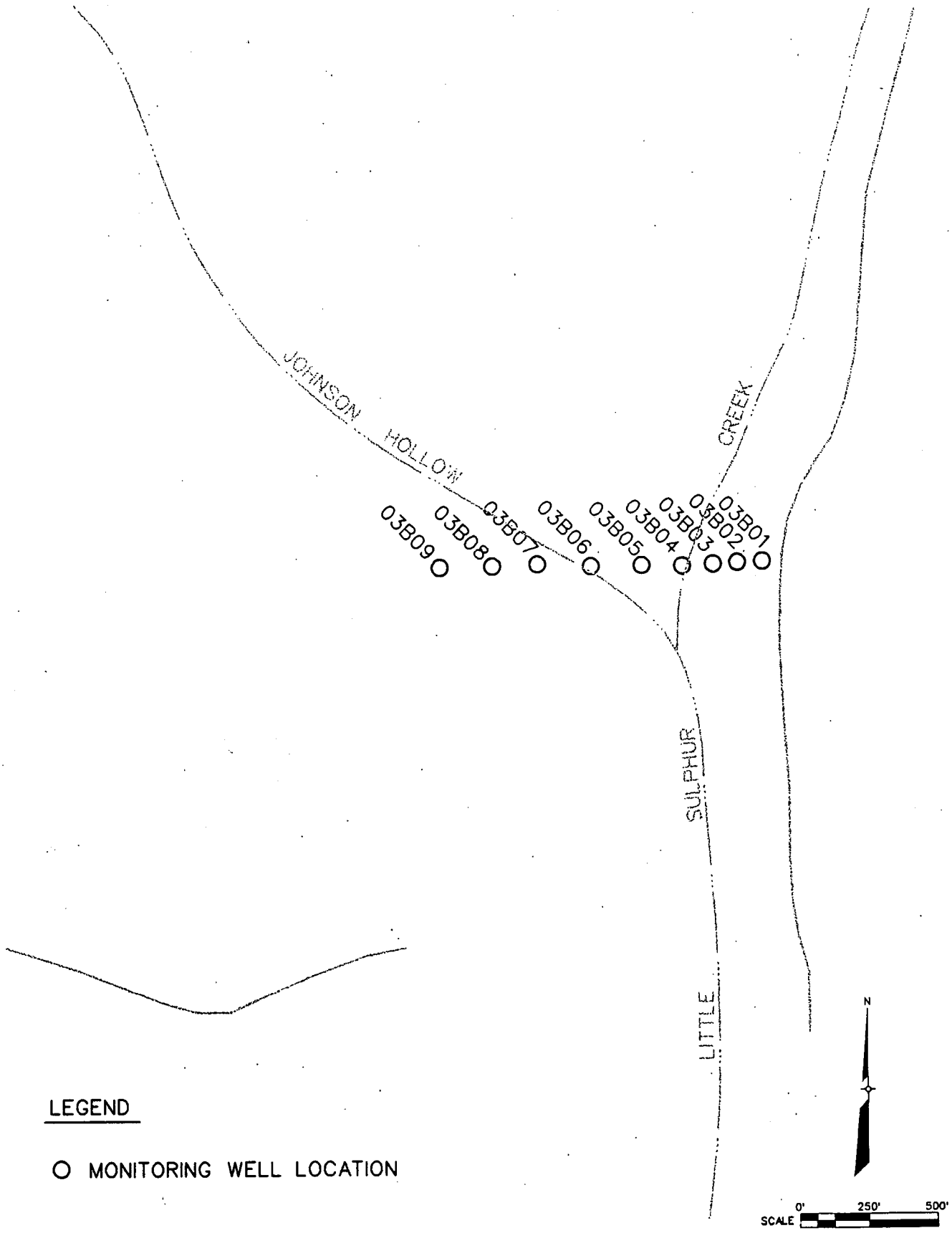
AMMUNITION BURNING GROUND GOLCONDA AQUIFER WELLS

NAVSURFWARCENDIV CRANE, INDIANA

JULY 1997

20626

DGN F:/132232/CRANEA4.DGN DATE



RUST

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FIGURE 4-11
AMMUNITION BURNING GROUND
ALLUVIUM AQUIFER WELLS

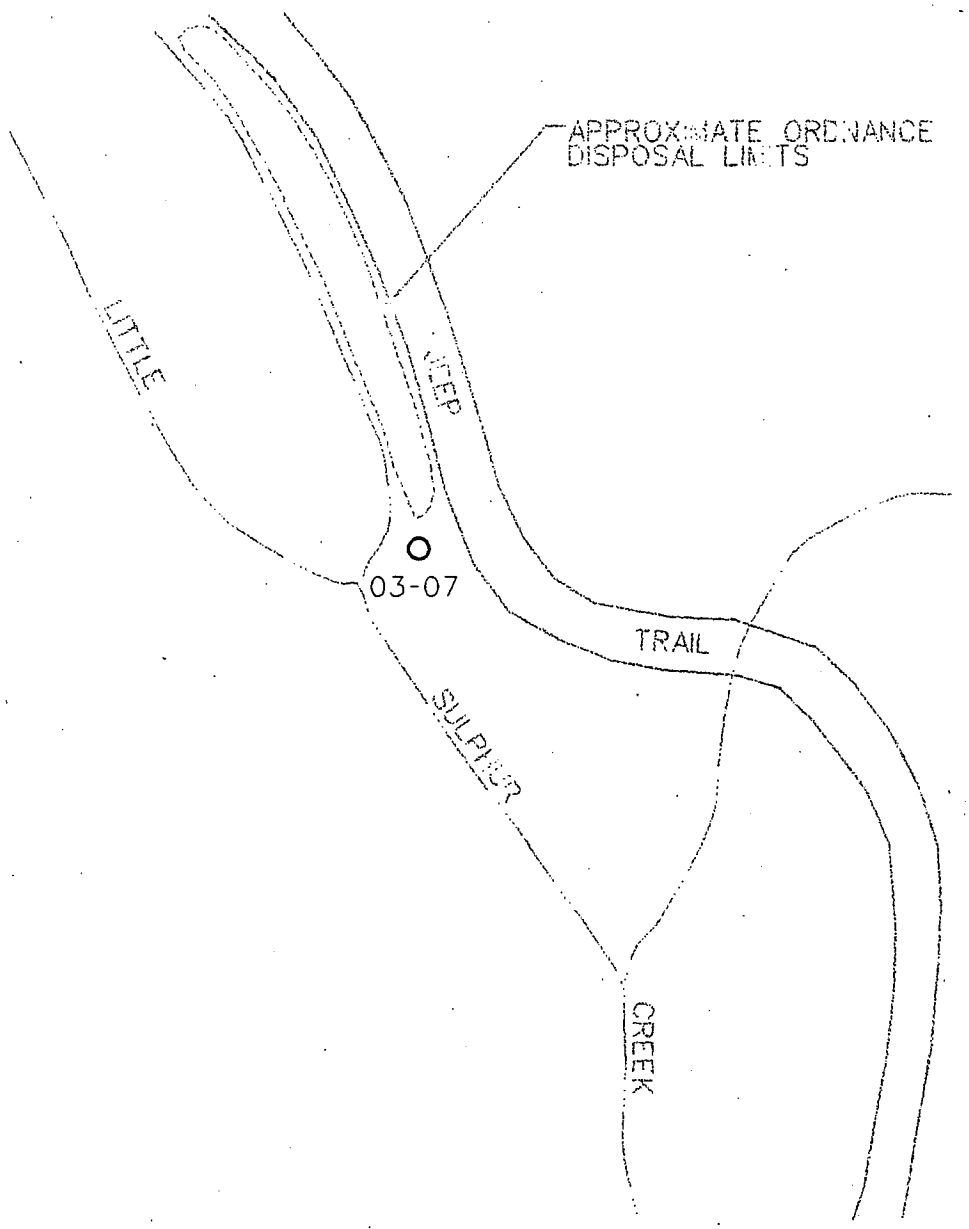
NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626

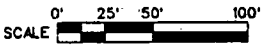
DATE

DGN F:/132232/AMMO4.DGN



LEGEND

O EXISTING MONITORING WELL



RUST

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FIGURE 4-12

JEEP TRAIL
ALLUVIUM AQUIFER WELLS

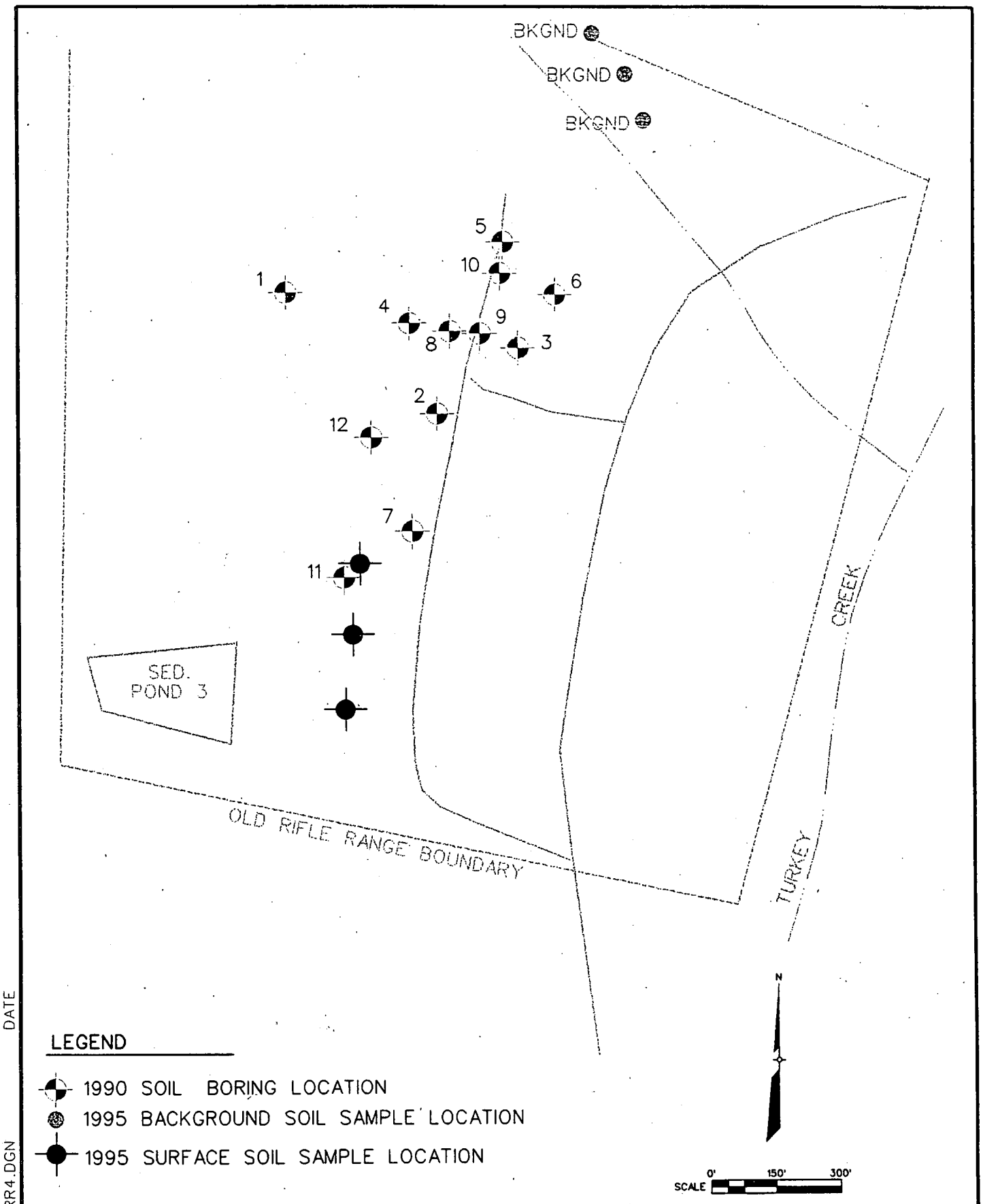
NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626

DATE

DGN F:/132232/JEEP1.DGN



DATE

DGNF:/132232/ORR4.DGN

RUST

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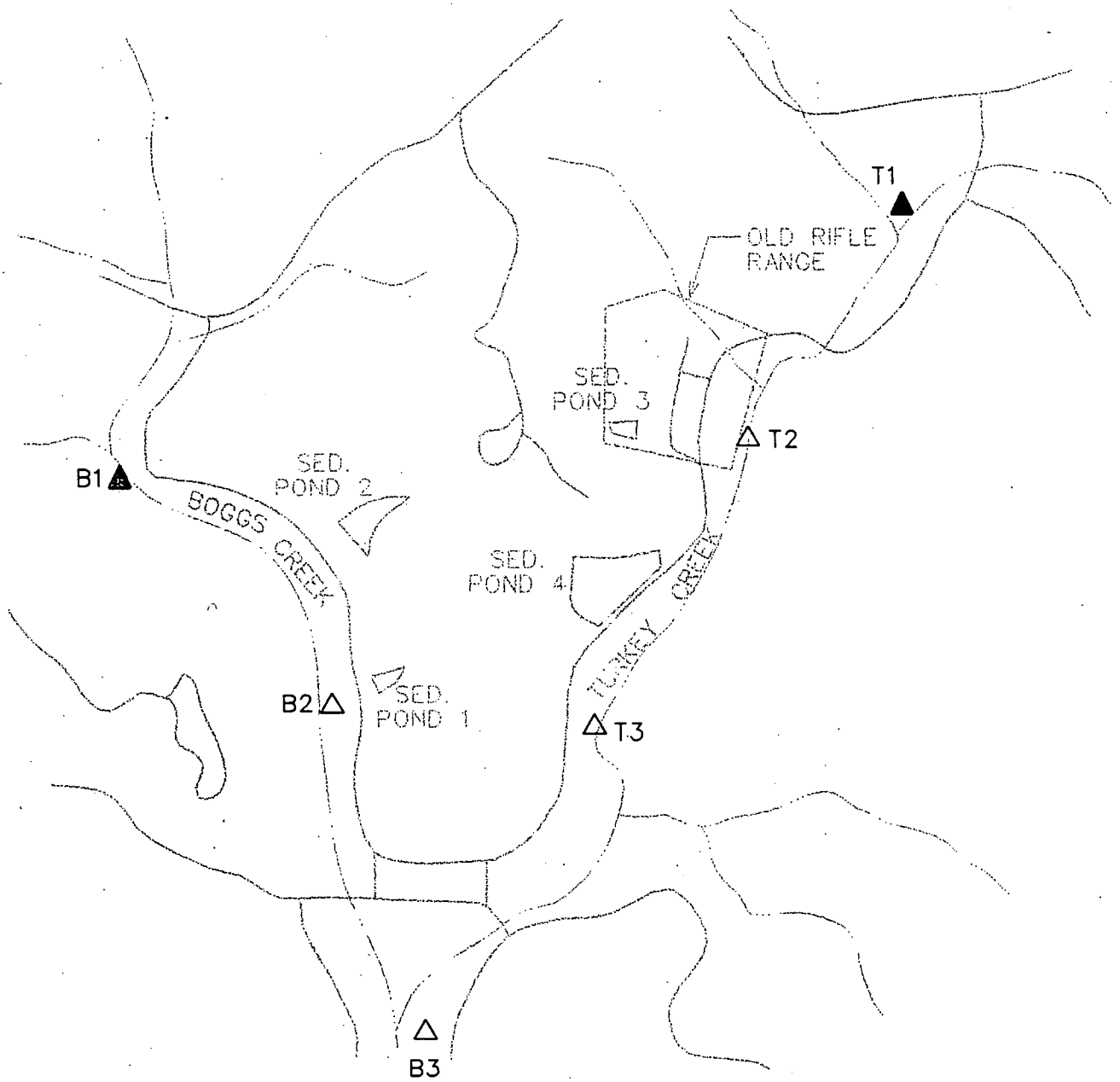
FIGURE 4-13
OLD RIFLE RANGE
SOIL SAMPLING LOCATIONS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626



LEGEND

▲ UPSTREAM SURFACE WATER/SEDIMENT SAMPLES

△ DOWNSTREAM SURFACE WATER/SEDIMENT SAMPLES

N

SCALE 0' 1000' 2000'

DATE

DGN/132232/AMMO2.DGN

RUST

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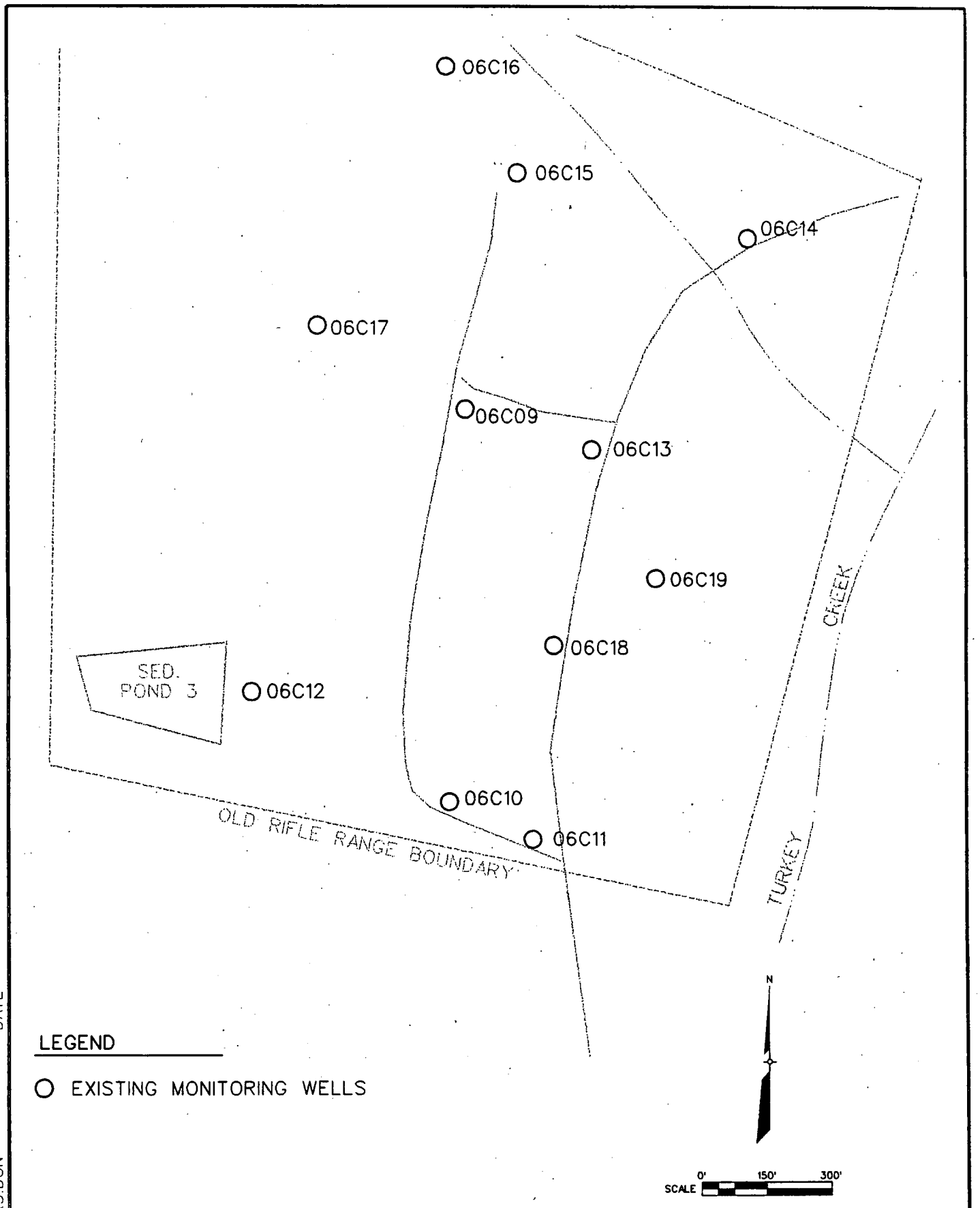
FIGURE 4-14
OLD RIFLE RANGE/DEMO.RANGE SURFACE WATER/SEDIMENT SAMPLING LOCATIONS
NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626



DATE

DGN/132232/ORR3.DGN

RUST

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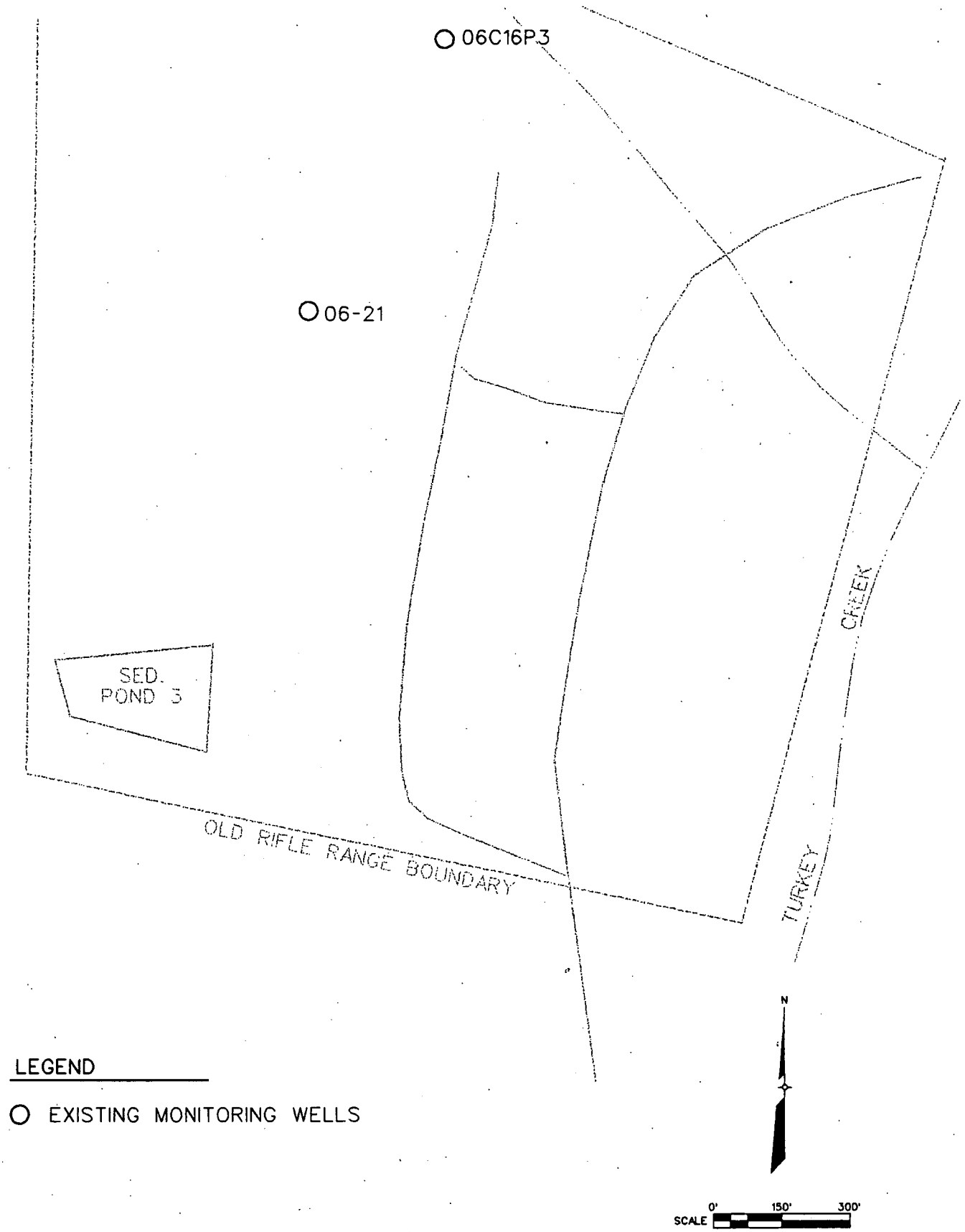
FIGURE 4-15

OLD RIFLE RANGE
BEECH CREEK AQUIFER WELLS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626



RUST

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FIGURE 4-16

OLD RIFLE RANGE
GOLCONDA AQUIFER WELLS

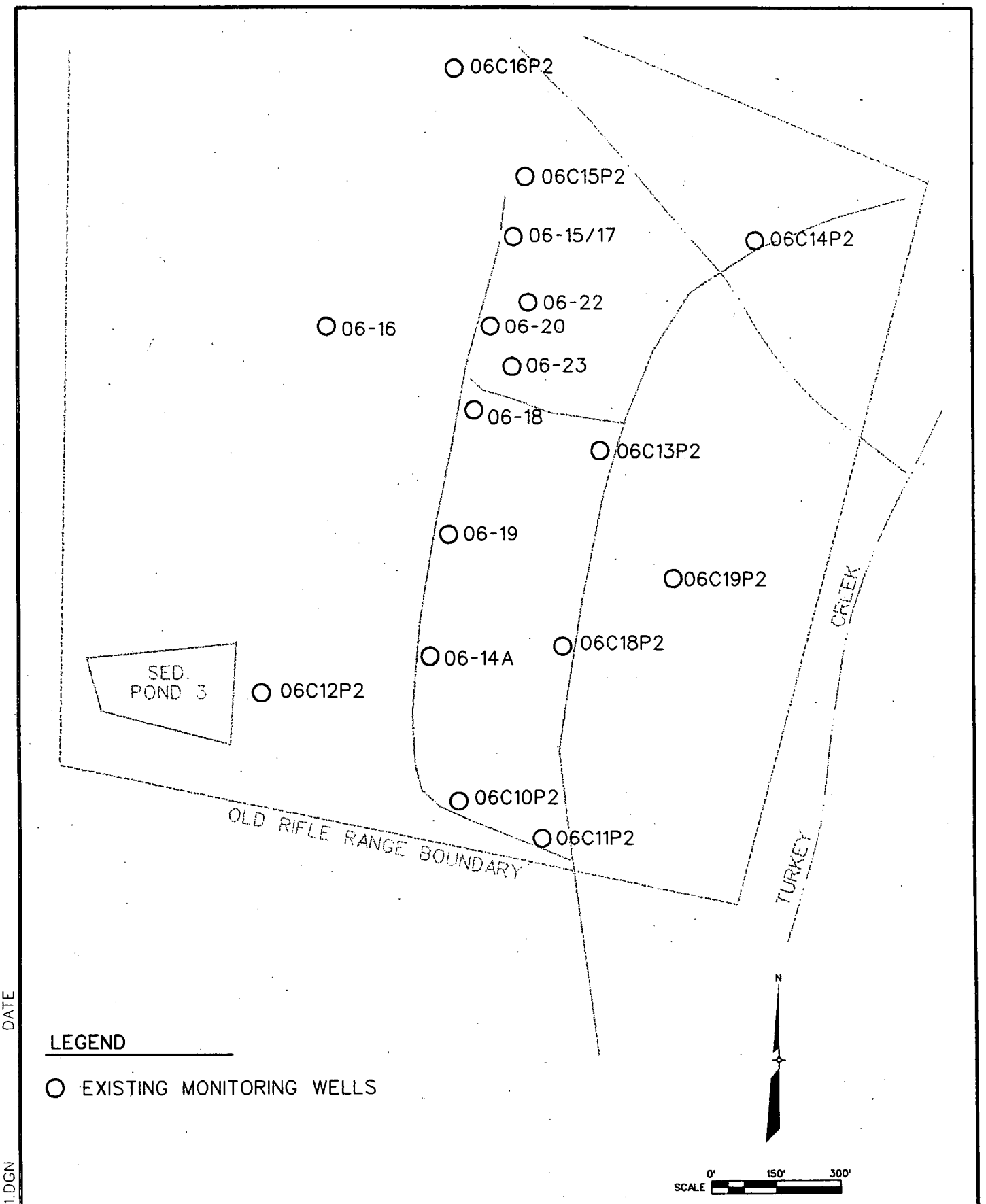
NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626

DATE

DGN/132232/ORR2.DGN



DATE

DGN/132232/ORR1.DGN

RUST

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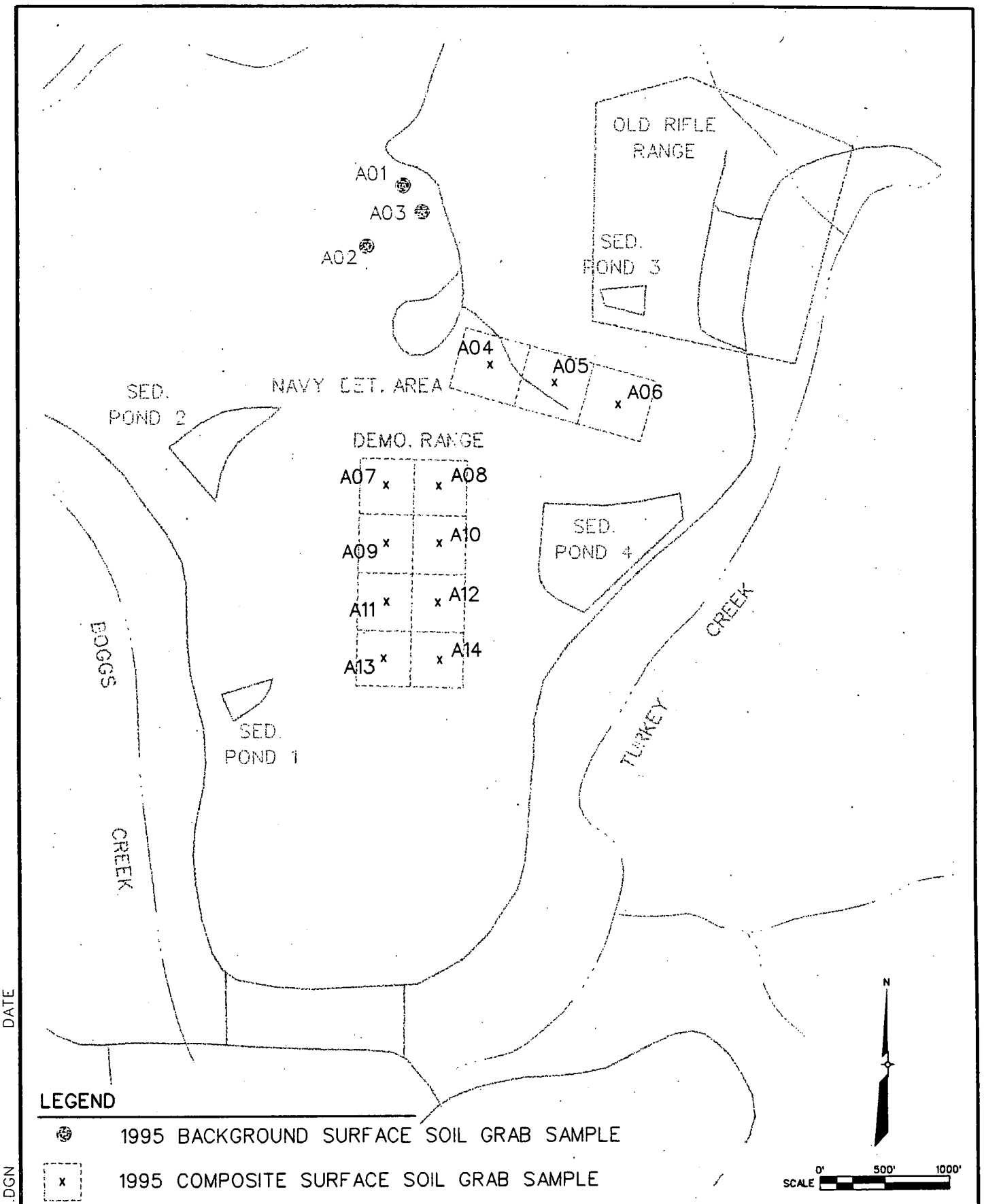
FIGURE 4-17

OLD RIFLE RANGE
SURFICIAL AQUIFER WELLS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626



DATE

DGN/132232/DR3.DGN

RUST

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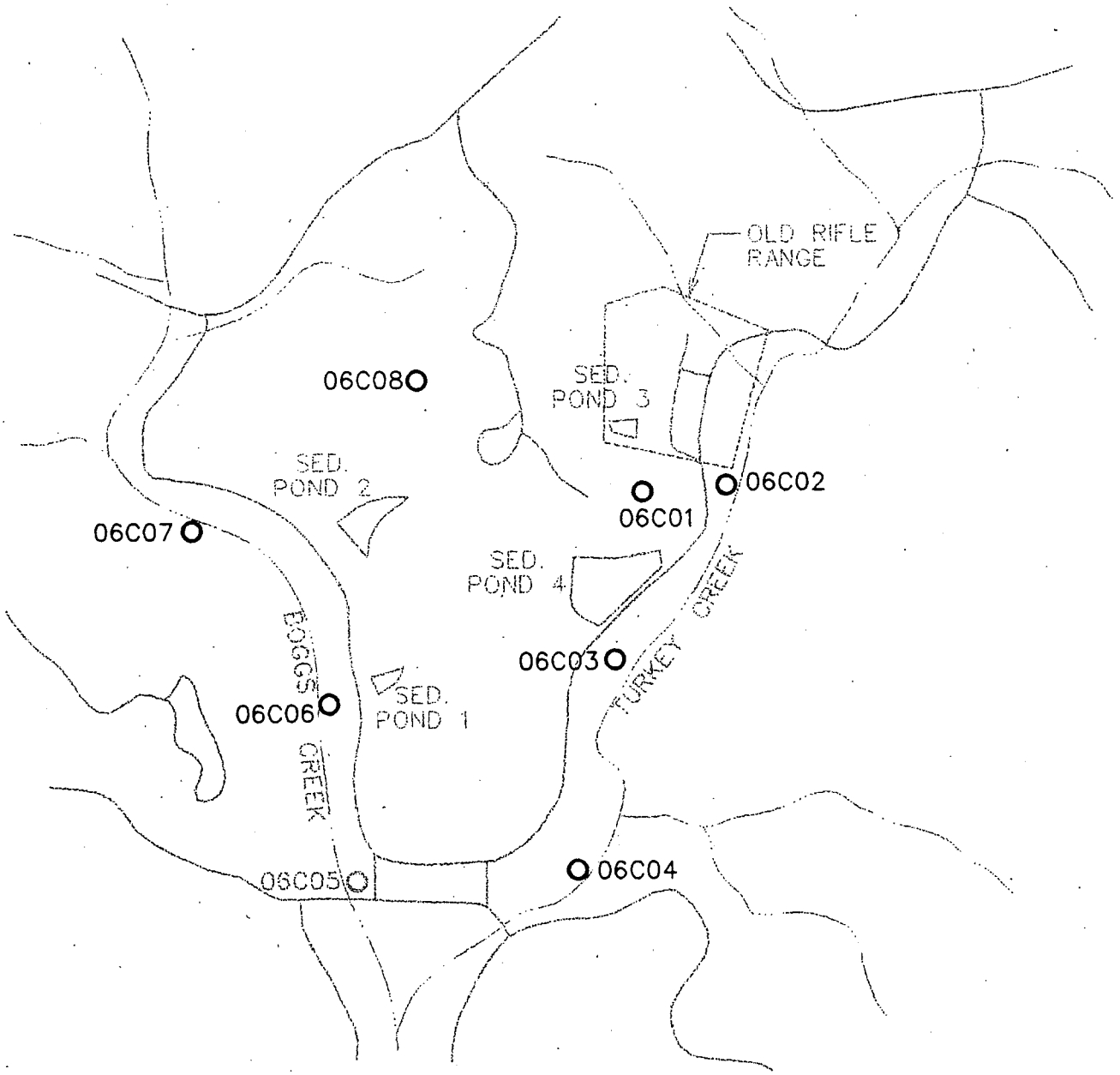
FIGURE 4-18

DEMOLITION RANGE
SOIL SAMPLING LOCATIONS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626



LEGEND

O EXISTING MONITORING WELL

N

SCALE 0' 1000' 2000'

DATE

DGN/132232/DR2.DGN

RUST

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FIGURE 4-19
DEMOLITION RANGE
BEECH CREEK AQUIFER WELLS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

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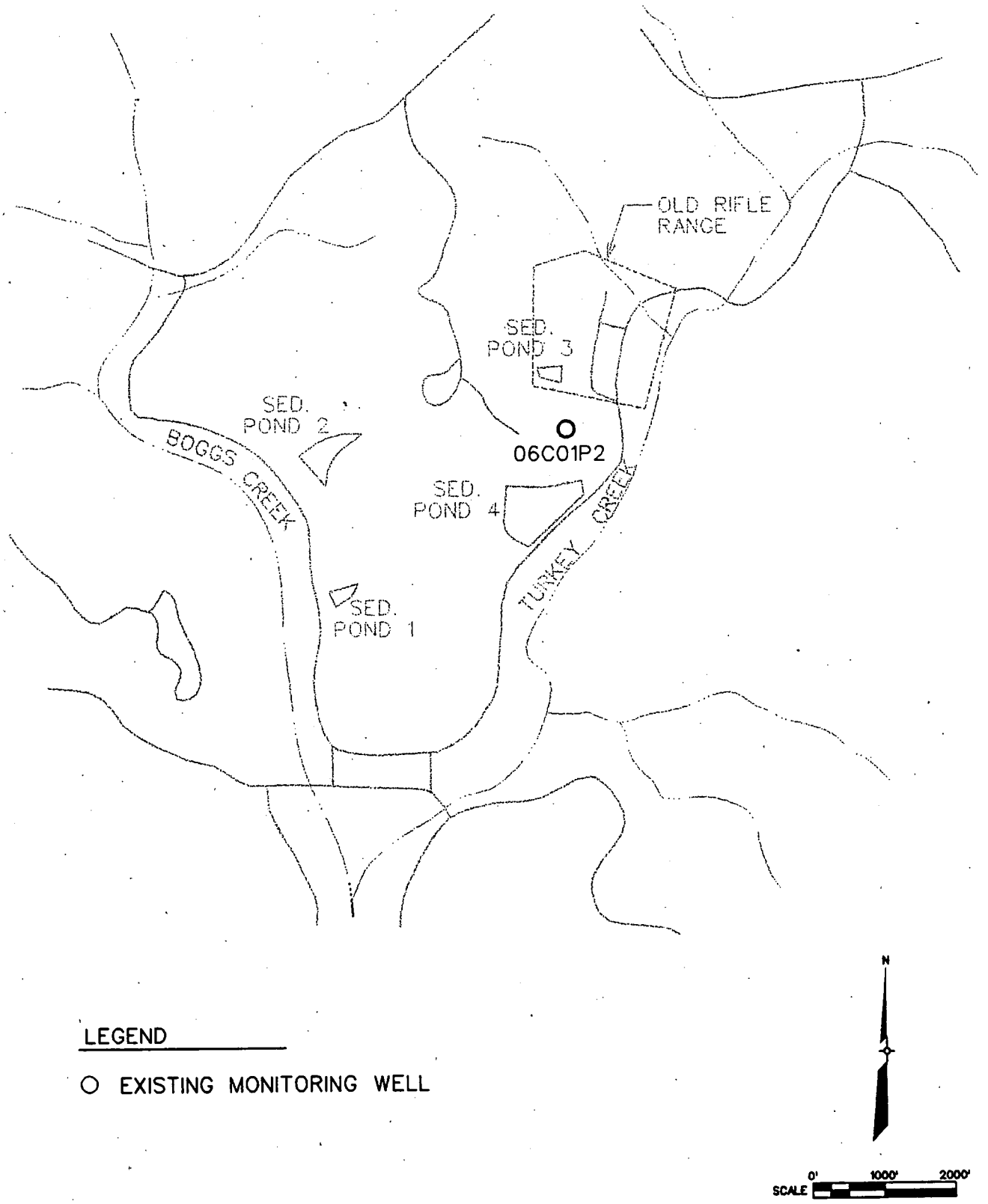

DATE

DGN/132232/DR1.DGN

RUST

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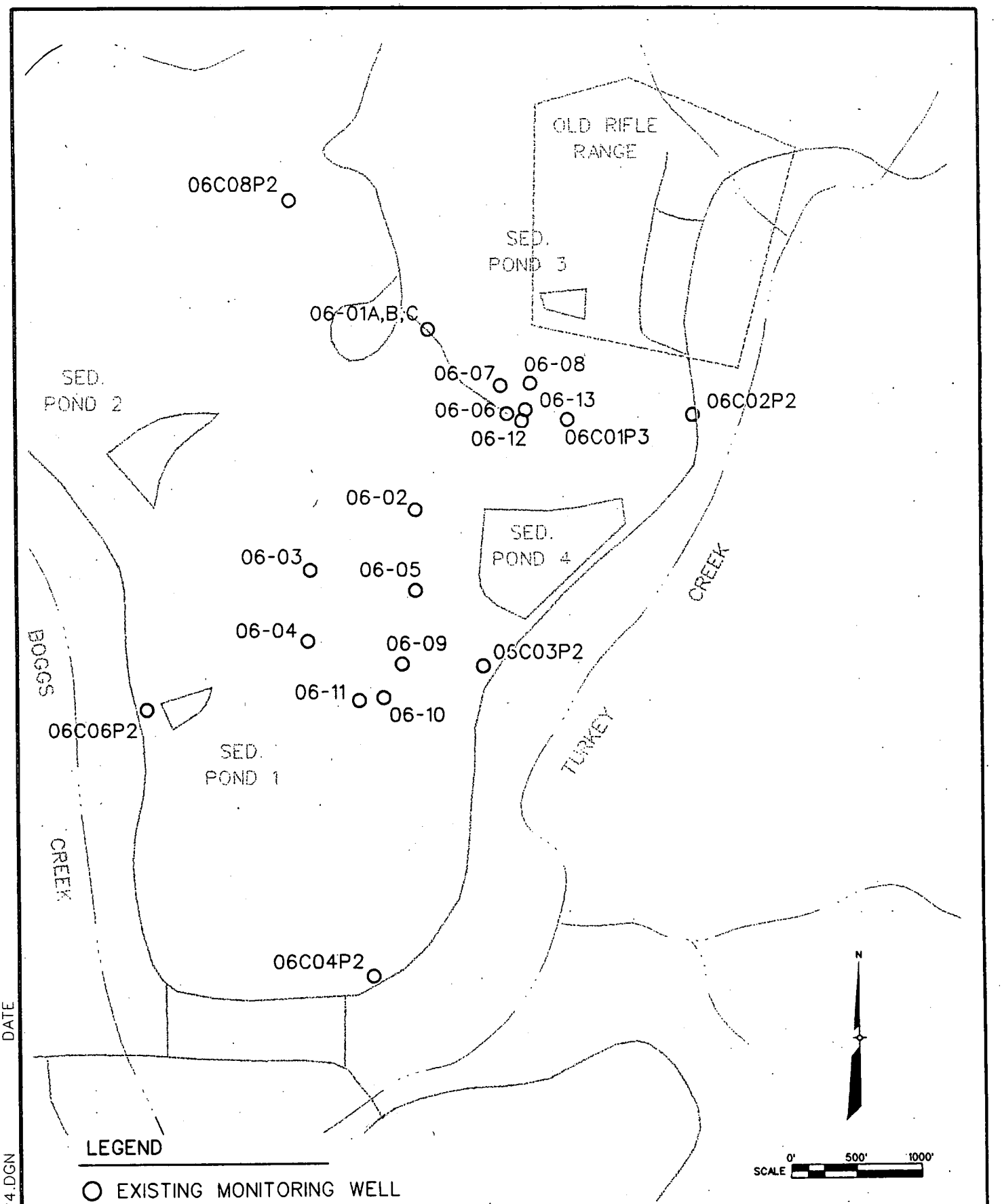
FIGURE 4-20
DEMOLITION RANGE
INTERMEDIATE ZONE AQUIFER WELLS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

20626



DATE

DGN F:/132232/DR4.DGN

RUST

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FIGURE 4-21

DEMOLITION RANGE
SURFICIAL AQUIFER WELLS

NAVSURFWARCENDIV
CRANE, INDIANA

JULY 1997

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APPENDIX 2-2

USEABLE HISTORICAL ENVIRONMENTAL MEDIA

DATA FOR ABG, ORR, AND DR

APPENDIX A

Historical Database

TABLE A-1.a.1
ABG SURFACE/SUBSURFACE SOIL SAMPLE RESULTS
1990 WES LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		01-90-1	01-90-2	02-90-1	02-90-2	03-90-1	03-90-2	04-90-1	04-90-2	05-90-1	05-90-2	06-90-1	06-90-2	07-90-1
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
EXPLOSIVES														
1,3-DINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
1,3,5-TRINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	1.37	12.6	0.241 J	0.347	<0.250 U	<0.250 U	1.29
2,4-DINITROTOLUENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	16.7	<0.250 U	1.41	0.530	<0.250 U	<0.250 U	<0.250 U
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	1.82	1640.0	0.435	3.93	0.141 J	0.126 J	2.57
HMX	MG/KG	<2.2 U	<2.2 U	<2.2 U	<2.2 U	<2.2 U	<2.2 U	2.23	1.19 J	27.2	128.0	9.66	2.58	41.9
RDX	MG/KG	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U	0.325 J	4.44	214.0	1070.0	0.761 J	0.450 J	0.856 J
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.650 U	<0.650 U	<0.65 U

SAMPLE NAME		07-90-2	07-90-3	08-90-1	08-90-2	09-90-1	10-90-1	10-90-2	10-90-3	11-90-1	12-90-1	12-90-2	12-90-3	02-90-3
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Subsurf.
EXPLOSIVES														
1,3-DINITROBENZENE	MG/KG	<0.250 U	0.128 J	<0.25 U	<0.25 U	<0.250 U	<0.250 U	<0.250 U	<0.25 U	<0.250 U	<0.25 U	<0.25 U	<0.25 U	<0.250 U
1,3,5-TRINITROBENZENE	MG/KG	0.708	3.44	<0.25 U	<0.25 U	0.172 J	<0.250 U	<0.250 U	<0.25 U	<0.250 U	0.277	0.218 J	0.466	<0.250 U
2,4-DINITROTOLUENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	0.686	69.1	<0.65 U	<0.65 U	<0.250 U	<0.65 U	<0.65 U	<0.65 U	0.167 J	0.417	0.420	0.474	<0.250 U
HMX	MG/KG	8.87	23.8	<2.2 U	<2.2 U	8.47	<2.2 U	<2.2 U	<2.2 U	0.338 J	6.84	10.4	8.95	<2.2 U
RDX	MG/KG	0.762 J	0.129 J	<1.0 U	<1.0 U	2.17	<1.0 U	<1.0 U	<1.0 U	<1.0 U	0.259 J	0.136 J	20.7	<1.0 U
TETRYL	MG/KG	<0.65 U	0.568	<0.25 U	<0.25 U	<0.65 U	<0.25 U	0.115 J	<0.25 U	<0.65 U	<0.65 U	<0.65 U	0.679	<0.65 U

SAMPLE NAME		02-90-4	03-90-3	04-90-3	04-90-4	05-90-3	06-90-3	06-90-4	06-90-5	07-90-4	09-90-2	09-90-3	10-90-4	10-90-5
ANALYTES	UNITS	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.
EXPLOSIVES														
1,3-DINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.25 U	<0.25 U
1,3,5-TRINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	0.358	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.25 U	<0.25 U
2,4-DINITROTOLUENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.250 U	<0.250 U	0.262	<0.250 U	56.2	0.104 J	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.65 U	<0.65 U
HMX	MG/KG	<2.2 U	<2.2 U	<2.2 U	<2.2 U	<2.2 U	0.341 J	0.956	0.232 J	<2.2 U	<2.2 U	<2.2 U	<2.2 U	<2.2 U
RDX	MG/KG	<1.0 U	<1.0 U	<1.0 U	<1.0 U	0.282 J	<1.0 U	0.354 J	0.276 J	<1.0 U	<1.0 U	<1.0 U	<1.0 U	<1.0 U
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.650 U	<0.650 U	<0.650 U	<0.65 U	<0.65 U	<0.65 U	<0.25 U	<0.25 U

SAMPLE NAME		11-90-2	11-90-3	11-90-4	12-90-4
ANALYTES	UNITS	Subsurf.	Subsurf.	Subsurf.	Subsurf.
EXPLOSIVES					
1,3-DINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.25 U
1,3,5-TRINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	0.519
2,4-DINITROTOLUENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.250 U	<0.250 U	0.164 J	1.00
HMX	MG/KG	<2.2 U	<2.2 U	1.16 J	5.05
RDX	MG/KG	<1.0 U	<1.0 U	<1.0 U	0.590 J
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	0.776

TABLE A-1.a.2
ABG SURFACE/SUBSURFACE SOIL SAMPLE RESULTS
1993 WES LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		01-93-1	01-93-1,D	02-93-1	05-93-1	06-93-1	07-93-1	08-93-1	08-93-1,D	09-93-1	10-93-1	11-93-1	12-93-1	13-93-1
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
EXPLOSIVES														
1,3-DINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
1,3,5-TRINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2-AMINO-4,6-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	0.196 J	0.215 J	0.200 J	<0.25 U	<0.25 U
2,4-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	4.20	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	11.6	<0.25 U
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	0.805	<0.25 U	<0.25 U	<0.25 U	0.181 J	<0.25 U	0.195 J	<0.25 U	<0.25 U
2,6-DINITROTOLUENE	MG/KG	<0.26 U	<0.26 U	<0.26 U	<0.26 U	0.115 J	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	0.375	<0.26 U
4-AMINO-2,6-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	0.060 J	<0.25 U	<0.25 U	<0.25 U	0.426	0.110 J	0.245 J	<0.25 U	<0.25 U
HMX	MG/KG	<2.20 U	<2.20 U	<2.20 U	<2.20 U	1.28 J	<2.20 U	<2.20 U	<2.20 U	9.85	1.11 J	0.450 J	<2.20 U	<2.20 U
RDX	MG/KG	<1.00 U	<1.00 U	<1.00 U	<1.00 U	0.085 J	<1.00 U	<1.00 U	<1.00 U	19.2	0.770 J	<1.00 U	<1.00 U	<1.00 U
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U

SAMPLE NAME		14-93-1	15-93-1	16-93-1	16-93-1,D	17-93-1	19-93-1	21-93-1	22-93-1	23-93-1	24-93-1	25-93-1	28-93-1	29-93-1
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
EXPLOSIVES														
1,3-DINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
1,3,5-TRINITROBENZENE	MG/KG	<0.25 U	2.45	<0.25 U	<0.25 U	2.10	0.660	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	0.065 J	2.26
2-AMINO-4,6-DINITROTOLUENE	MG/KG	<0.25 U	0.260	<0.25 U	<0.25 U	2.20	<0.25 U	<0.25 U	<0.25 U	0.125 J	<0.25 U	<0.25 U	0.025 J	1.56
2,4-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	0.170	0.090 J	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	0.065 J
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.25 U	1.61	<0.25 U	0.125 J	7.55	0.360	<0.25 U	<0.25 U	0.335	<0.25 U	<0.25 U	12.3	0.685
2,6-DINITROTOLUENE	MG/KG	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U
4-AMINO-2,6-DINITROTOLUENE	MG/KG	<0.25 U	0.180 J	<0.25	<0.25	2.48	<0.25 U	<0.25 U	<0.25 U	0.080 J	<0.25 U	<0.25 U	<0.25 U	1.57
HMX	MG/KG	<2.20 U	<2.20 U	0.520 J	<2.20 U	14.6	16.0	<2.20 U	<2.20 U	0.250 J	<2.20 U	<2.20 U	5.45	128
RDX	MG/KG	<1.00 U	<1.00	0.060 J	0.075 J	18.8	1.41	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	16.4	41.2
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U

SAMPLE NAME		31-93-1	32-93-1	33-93-1	33-93-1,D	34-93-1	35-93-1	36-93-1	37-93-1	37-93-1,D	38-93-1	39-93-1	40-93-1	41-93-1
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
EXPLOSIVES														
1,3-DINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25	<0.25	<0.25
1,3,5-TRINITROBENZENE	MG/KG	0.260	<0.25 U	<0.25 U	<0.25 U	<0.25 U	0.225 J	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25	<0.25	<0.25
2-AMINO-4,6-DINITROTOLUENE	MG/KG	0.010 J	<0.25 U	<0.25 U	<0.25 U	<0.25 U	1.38	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25	<0.25	<0.25
2,4-DINITROTOLUENE	MG/KG	0.100 J	<0.25 U	<0.25 U	<0.25 U	<0.25 U	0.060 J	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25	<0.25	<0.25
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	0.040 J	<0.25 U	<0.25 U	0.020 J	<0.25 U	2.78	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25	<0.25	<0.25
2,6-DINITROTOLUENE	MG/KG	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26	<0.26	<0.26
4-AMINO-2,6-DINITROTOLUENE	MG/KG	0.125 J	<0.25 U	<0.25 U	<0.25 U	<0.25 U	1.18	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25	<0.25	<0.25
HMX	MG/KG	1.29 J	0.410 J	<2.20 U	0.035 J	<2.20 U	117	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20	<2.20	<2.20
RDX	MG/KG	0.235 J	<1.00 U	<1.00 U	<1.00 U	<1.00 U	1.35	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00	<1.00	<1.00
TETRYL	MG/KG	<0.65 U	<0.65 U	<65.0 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65	<0.65	<0.65

TABLE A-1.a.2
ABG SURFACE/SUBSURFACE SOIL SAMPLE RESULTS
1993 WES LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		42-93-1	43-93-1	44-93-1	45-93-1	46-93-1	47-93-1	48-93-1	48-93-1,D	49-93-1	50-93-1	50-93-1,D	51-93-1	52-93-1
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
EXPLOSIVES														
1,3-DINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25	<0.250 U	<0.25 U	<0.25 U	<0.25 U	<0.250 U	<0.250 U	<0.250 U	<0.25 U
1,3,5-TRINITROBENZENE	MG/KG	0.235 J	<0.25 U	0.095 J	0.495	<0.25	<0.250 U	0.460	0.055 J	<0.25 U	<0.250 U	<0.250 U	<0.250 U	0.100 J
2-AMINO-4,6-DINITROTOLUENE	MG/KG	0.580	<0.25 U	0.440	<0.25 U	<0.25	<0.250 U	0.620	0.165 J	0.175 J	0.150 J	0.245 J	<0.250 U	0.270
2,4-DINITROTOLUENE	MG/KG	0.130 J	1.30	<0.25 U	0.015 J	<0.25	<0.250 U	0.115 J	0.025 J	1.06	<0.25 U	<0.250 U	<0.25 U	0.840
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	0.925	0.161 J	0.220	0.055 J	<0.25	<0.250 U	18.2	0.705	0.150 J	0.425	3.22	0.695	0.475
2,6-DINITROTOLUENE	MG/KG	<0.26 U	0.305	0.150 J	<0.26 U	<0.26	<0.260 U	<0.26 U	<0.26 U	0.575	<0.260 U	<0.260 U	<0.260 U	0.355
4-AMINO-2,6-DINITROTOLUENE	MG/KG	0.750	0.120 J	0.385	0.135 J	<0.25	<0.250 U	<0.25 U	0.250	0.260	0.165 J	0.225 J	0.120 J	0.505
HMX	MG/KG	8.90	3.74	6.05	11.4	<2.20	<2.20 U	0.280 J	0.025 J	3.16	<2.20 U	0.090 J	0.290 J	1.38 J
RDX	MG/KG	3.58	0.445 J	10.9	0.480 J	<1.00	<1.00 U	19.5	0.670 J	0.415 J	<1.00 U	<1.00 U	0.635 J	0.820 J
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65	<0.650 U	<0.65 U	<0.65 U	<0.65 U	<0.650 U	<0.650 U	<0.650 U	<0.65 U

SAMPLE NAME		53-93-1	54-93-1	54-93-1,D	55-93-1	56-93-1	57-93-1	58-93-1	59-93-1	60-93-1	61-93-1	62-93-1	63-93-1	64-93-1
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
EXPLOSIVES														
1,3-DINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.250 U	<0.250 U	<0.250 U	<0.25 U	<0.25 U	<0.250 U	<0.25 U	<0.25 U	<0.25 U	<0.25
1,3,5-TRINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.250 U	<0.250 U	<0.250 U	<0.25 U	<0.25 U	<0.250 U	1.44	1.60	<0.25 U	<0.25
2-AMINO-4,6-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.250 U	0.475	<0.250 U	0.030 J	<0.25 U	<0.250 U	5.65	0.205 J	<0.25 U	<0.25
2,4-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	0.125 J	<0.25 U	0.045 J	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.250 U	136	0.130 J	0.045 J	<0.25 U	<0.250 U	19.8	0.565	<0.25 U	<0.25
2,6-DINITROTOLUENE	MG/KG	<0.26 U	<0.26 U	<0.25 U	<0.260 U	<0.260 U	<0.260 U	0.100 J	<0.26 U	<0.260 U	<0.26 U	<0.26 U	<0.26 U	<0.26
4-AMINO-2,6-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.250 U	<0.250 U	<0.250 U	0.075 J	<0.25 U	<0.250 U	8.20	0.340	<0.25 U	0.105 J
HMX	MG/KG	<2.20 U	<2.20 U	<2.20 U	<2.20 U	0.190 J	9.20	0.105 J	<2.20 U	<2.20 U	223	19.2	<2.20 U	<2.20
RDX	MG/KG	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	0.035 J	<1.00 U	<1.00 U	1820	3.02	<1.00 U	<1.00
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.650 U	<0.650 U	<0.650 U	<0.65 U	<0.65 U	<0.650 U	<0.65 U	<0.65 U	<0.65 U	<0.65

SAMPLE NAME		65-93-1	66-93-1	67-93-1	68-93-1	69-93-1	70-93-1	71-93-1	03-93-2	05-93-2	06-93-2	07-93-2	10-93-2	11-93-2
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.
EXPLOSIVES														
1,3-DINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25	<0.25	<0.25	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
1,3,5-TRINITROBENZENE	MG/KG	<0.25 U	<0.25 U	0.195 J	0.115 J	<0.25	<0.25	<0.25	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2-AMINO-4,6-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	0.250	<0.25 U	<0.25	<0.25	<0.25	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2,4-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	0.095 J	<0.25 U	<0.25	<0.25	<0.25	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	0.060 J	0.175 J	1.38	0.100 J	3.82	<0.25	<0.25	<0.25 U	<0.25 U	0.138 J	<0.25 U	<0.25 U	<0.25 U
2,6-DINITROTOLUENE	MG/KG	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26	<0.26	<0.26	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U
4-AMINO-2,6-DINITROTOLUENE	MG/KG	<0.25 U	0.060 J	0.440	0.125 J	0.760	<0.25	<0.25	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
HMX	MG/KG	6.05	0.125 J	2.88	0.170 J	64.0	1.50 J	0.295 J	<2.20 U	<2.20 U	0.099 J	<2.20 U	1.24 J	<2.20 U
RDX	MG/KG	<1.00 U	<1.00 U	1.36	<1.00 U	192	<1.00	<1.00	<1.00 U	<1.00 U	<1.00 U	<0.100 U	<1.00 U	<1.00 U
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65	<0.65	<0.65	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U

TABLE A-1.a.2
ABG SURFACE/SUBSURFACE SOIL SAMPLE RESULTS
1993 WES LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		12-93-2	12-93-3	13-93-2	14-93-2	17-93-2	17-93-3	19-93-2	19-93-3	21-93-2	21-93-3	22-93-2	22-93-3	23-93-2
ANALYTES	UNITS	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.
EXPLOSIVES														
1,3-DINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
1,3,5-TRINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	2.96	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2-AMINO-4,6-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	1.24	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2,4-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	0.075 J	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	60.7	2.28	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2,6-DINITROTOLUENE	MG/KG	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U
4-AMINO-2,6-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	2.16	0.105 J	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
HMX	MG/KG	<2.20 U	<2.20 U	<2.20 U	<2.20 U	61.0	3.36	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	0.080 J
RDX	MG/KG	<1.00 U	<1.00 U	<1.00 U	<1.00 U	274	10.2	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U

SAMPLE NAME		23-93-3	25-93-2	28-93-2	28-93-3	29-93-2	34-93-2	35-93-2	38-93-2
ANALYTES	UNITS	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.
EXPLOSIVES									
1,3-DINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<25.0 U	<0.25 U
1,3,5-TRINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	37.5	<0.25 U
2-AMINO-4,6-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	0.085 J	0.125 J	<0.25 U	<25.0 U	<0.25 U
2,4-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	0.030 J	<0.25 U	<0.25 U	<25.0 U	<0.25 U
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.25 U	<0.25 U	1.25	0.260	0.020 J	<0.25 U	2030	<0.25 U
2,6-DINITROTOLUENE	MG/KG	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<0.26 U	<26.0 U	<0.26 U
4-AMINO-2,6-DINITROTOLUENE	MG/KG	<0.25 U	<0.25 U	0.020 J	0.080 J	0.060 J	<0.25 U	<25.0 U	<0.25 U
HMX	MG/KG	<2.20 U	<2.20 U	3.80	<2.20 U	0.600 J	<2.20 U	232	<2.20 U
RDX	MG/KG	0.265	<1.00 U	2.06	<1.00 U	0.350 J	<1.00 U	60.5 J	<1.00 U
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<65.0 U	<0.65 U

TABLE A-1.c.1a
ABG SURFACE WATER SAMPLE RESULTS
1992 WES LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		ABGW 01	ABGW 02	ABGW 03	ABGW 04	ABGW 05	ABGW 06	ABGW 07	ABGW 08	ABGW 09	ABGW 10	ABGW 11
ANALYTES	UNITS\DATE	APRIL	APRIL	APRIL	APRIL	APRIL	APRIL	APRIL	APRIL	APRIL	APRIL	APRIL
EXPLOSIVES												
1,3-DINITROBENZENE	MG/L	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U
1,3,5-TRINITROBENZENE	MG/L	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U
2,4-DINITROTOLUENE	MG/L	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U
2,6-DINITROTOLUENE	MG/L	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U
HMX	MG/L	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	0.045	<0.02 U	<0.02 U
RDX	MG/L	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U
TETRYL	MG/L	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U

SAMPLE NAME		ABGW 01	ABGW 02	ABGW 03	ABGW 04	ABGW 05	ABGW 06	ABGW 07	ABGW 08	ABGW 09	ABGW 10	ABGW 11
ANALYTES	UNITS\DATE	JULY	JULY	JULY	JULY	JULY	JULY	JULY	JULY	JULY	JULY	JULY
EXPLOSIVES												
1,3-DINITROBENZENE	MG/L	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U
1,3,5-TRINITROBENZENE	MG/L	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U
2,4-DINITROTOLUENE	MG/L	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U
2,6-DINITROTOLUENE	MG/L	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U	<0.01 U
HMX	MG/L	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	0.035	0.025	<0.02 U	<0.02 U	0.014 J
RDX	MG/L	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	<0.02 U	0.037	0.024	<0.02 U	<0.02 U	<0.02 U
TETRYL	MG/L	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U	<0.05 U

TABLE A-1.c.1b
ABG SEDIMENT SAMPLE RESULTS
1992 WES LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		ABGS 01	ABGS 02	ABGS 03	ABGS 04	ABGS 05	ABGS 06	ABGS 07	ABGS 08	ABGS 09	ABGS 10	ABGS 11
ANALYTES	UNITS\DATE	APRIL	APRIL	APRIL	APRIL	APRIL	APRIL	APRIL	APRIL	APRIL	APRIL	APRIL
EXPLOSIVES												
1,3-DINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
1,3,5-TRINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
2,4-DINITROTOLUENE	MG/KG	<0.85 U	<0.9 U	<0.85 U	<0.85 U	<0.85 U	<0.82 U	<0.82 U	<0.75 U	<0.87 U	<0.87 U	1.1
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.25 U	<0.25 U	<0.25 U	0.18 J	0.26	0.14 J	0.12 J	1.13	0.17 J	0.11 J	0.27
2,6-DINITROTOLUENE	MG/KG	<0.85 U	<0.9 U	<0.85 U	<0.85 U	<0.85 U	<0.82 U	<0.82 U	<0.75 U	<0.87 U	<0.87 U	<0.87 U
HMX	MG/KG	<2.2 U	<2.2 U	<2.2 U	10.2	<2.2 U	1.37 J	1.46 J	2.9	0.32 J	0.78 J	<2.2 U
RDX	MG/KG	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U	<1 U
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U

SAMPLE NAME		ABGS 01	ABGS 02	ABGS 03	ABGS 04	ABGS 05	ABGS 06	ABGS 07	ABGS 08	ABGS 09	ABGS 10	ABGS 11
ANALYTES	UNITS\DATE	JULY	JULY	JULY	JULY	JULY	JULY	JULY	JULY	JULY	JULY	JULY
EXPLOSIVES												
1,3-DINITROBENZENE	MG/KG	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U	<0.25 U
1,3,5-TRINITROBENZENE	MG/KG	<0.25 U	0.05 J	0.2 J	<0.25 U	<0.25 U	<0.25 U	0.07 J	<0.25 U	0.085 J	0.085 J	<0.25 U
2,4-DINITROTOLUENE	MG/KG	<0.82 U	<0.85 U	0.55 J	<0.85 U	<0.75 U	<0.79 U	<0.9 U	<0.9 U	<0.83 U	<0.83 U	2.3
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.25 U	0.094 J	1.02	<0.25 U	<0.25 U	0.14 J	0.07 J	0.995	0.795	0.675	0.18 J
2,6-DINITROTOLUENE	MG/KG	<0.82 U	<0.85 U	<0.81 U	<0.85 U	<0.75 U	<0.79 U	<0.9 U	<0.9 U	<0.83 U	<0.83 U	<0.83 U
HMX	MG/KG	<2.2 U	<2.2 U	1.7 J	<2.2 U	<2.2 U	1.24 J	0.25 J	0.85 J	0.17 J	0.145 J	<2.2 U
RDX	MG/KG	<1 U	<1 U	0.405 J	<1 U	<1 U	1.78	<1 U	<1 U	<1 U	<1 U	<1 U
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U

TABLE A-1.d.1
ABG SPRING WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SPR-A	03-SPR-B	03-SPR-C	03-SPR-C,D
ANALYTES	UNITS\ DATE	AUG/SEP	AUG/SEP	AUG/SEP	AUG/SEP
EXPLOSIVES					
1,3-DINITROBENZENE	UG/L	2 U	2 U	0 U	2 U
1,3-DINITROBENZENE(2)	UG/L	10 U	10 U	10 U	
1,3,5-TRINITROBENZENE	UG/L	0.81 VJ	2 U	0 U	2 U
1,3,5-TRINITROBENZENE(2)	UG/L	10 U	10 U	10 U	
2,4-DINITROTOLUENE	UG/L	2 U	2 U	0 U	2 U
2,4-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	
2,4,6-TRINITROTOLUENE (TNT)	UG/L	2 V	2 U	0 U	2 U
2,6-DINITROTOLUENE	UG/L	2 U	2 U	0 U	2 U
2,6-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	
HMX	UG/L	24 V	2 U	0	3 V
NITROBENZENE	UG/L	2 U	2 U	0 U	2 U
NITROBENZENE(2)	UG/L	10 U	10 U	10 U	
RDX	UG/L	57 V	2 U	0	8.4 V
TETRYL	UG/L	2 U	2 U	0 U	2 U
INORGANICS					
ALUMINUM, DISSOLVED	MG/L	0.2 U	0.2 U	0	0.2 U
ALUMINUM, TOTAL	MG/L	0.2 U	0.22	0	0.33
ANTIMONY, DISSOLVED	MG/L	0.2 U	0.2 U	0 U	0.2 U
ANTIMONY, TOTAL	MG/L	0.2 U	0.2 U	0 U	0.2 U
ARSENIC, DISSOLVED	MG/L	0.005 U	0.005 U	0 U	0.005 U
ARSENIC, TOTAL	MG/L	0.005 U	0.005 U	0 U	0.005 U
BARIUM, DISSOLVED	MG/L	0.12	0.1 U	0 U	0.1 U
BARIUM, TOTAL	MG/L	0.11	0.1 U	0 U	0.1 U
BERYLLIUM, DISSOLVED	MG/L	0.002 U	0.002 U	0 U	0.002 U
BERYLLIUM, TOTAL	MG/L	0.002 U	0.002 U	0 U	0.002 U
CADMIUM, DISSOLVED	MG/L	0.005 U	0.005 U	0 U	0.005 U
CADMIUM, TOTAL	MG/L	0.005 U	0.005 U	0 U	0.005 U
CHROMIUM, DISSOLVED	MG/L	0.03 U	0.03 U	0 U	0.03 U
CHROMIUM, TOTAL	MG/L	0.03 U	0.03 U	0 U	0.03 U
COBALT, DISSOLVED	MG/L	0.04 U	0.04 U	0 U	0.04 U
COBALT, TOTAL	MG/L	0.04 U	0.04 U	0 U	0.04 U
COPPER, DISSOLVED	MG/L	0.03 U	0.03 U	0 U	0.03 U
COPPER, TOTAL	MG/L	0.03 U	0.03 U	0 U	0.03 U
CYANIDE	MG/L	0.01 U	0.01 U	0 U	0.01 U
IRON, DISSOLVED	MG/L	0.041	0.04 U	0	0.058
IRON, TOTAL	MG/L	0.065	0.28	0	0.32
LEAD, DISSOLVED	MG/L	0.005 U	0.005 U	0 U	0.005 U
LEAD, TOTAL	MG/L	0.005 U	0.005 U	0 U	0.005 U

SAMPLE NAME		03-SPR-A	03-SPR-B	03-SPR-C	03-SPR-C,D
ANALYTES	UNITS\ DATE	AUG/SEP	AUG/SEP	AUG/SEP	AUG/SEP
INORGANICS(CONT'D..)					
MANGANESE, DISSOLVED	MG/L	0.01 U	0.01 U	0 U	0.01 U
MANGANESE, TOTAL	MG/L	0.01 U	0.022	0 U	0.01 U
MERCURY, DISSOLVED	MG/L	0.0002 U	0.0002 U	0 U	0.0002 U
MERCURY, TOTAL	MG/L	0.0002 U	0.0002 U	0 U	0.0002 U
NICKEL, DISSOLVED	MG/L	0.04 U	0.04 U	0 U	0.04 U
NICKEL, TOTAL	MG/L	0.04 U	0.04 U	0 U	0.04 U
SELENIUM, DISSOLVED	MG/L	0.005 U	0.005 U	0 U	0.005 U
SELENIUM, TOTAL	MG/L	0.005 U	0.005 U	0 U	0.005 U
SILVER, DISSOLVED	MG/L	0.03 U	0.03 U	0 U	0.03 U
SILVER, TOTAL	MG/L	0.03 U	0.03 U	0 U	0.03 U
THALLIUM, DISSOLVED	MG/L	0.010 U	0.005 U	0 U	0.005 U
THALLIUM, TOTAL	MG/L	0.005 U	0.005 U	0 U	0.005 U
TIN, DISSOLVED	MG/L	0.1 U	0.1 U	0.1 U	
TIN, TOTAL	MG/L	0.1 U	0.1 U	0.1 U	
VANADIUM, DISSOLVED	MG/L	0.04 U	0.04 U	0 U	0.04 U
VANADIUM, TOTAL	MG/L	0.04 U	0.04 U	0 U	0.04 U
ZINC, DISSOLVED	MG/L	0.01 U	0.01 U	0.011	0 U
ZINC, TOTAL	MG/L	0.01 U	0.013 B	0 U	0.01 U
PCBs					
PCB-1016	UG/L	1 U	1 U	1 U	
PCB-1221	UG/L	1 U	1 U	1 U	
PCB-1232	UG/L	1 U	1 U	1 U	
PCB-1242	UG/L	1 U	1 U	1 U	
PCB-1248	UG/L	1 U	1 U	1 U	
PCB-1254	UG/L	1 U	1 U	0 U	1 U
PCB-1260	UG/L	1 U	1 U	1 U	
PESTICIDES					
1,4-DIOXANE	UG/L	500 UR	500 U	500 U	
2,4-D	UG/L	1.2 U	1.2 U	0 U	1.2 U
2,4,5-T	UG/L	0.2 U	0.2 U	0 U	0.2 U
2,4,5-TP	UG/L	0.17 U	0.17 U	0 U	0.17 U
4,4'-DDD	UG/L	0.1 U	0.1 U	0.1 U	
4,4'-DDE	UG/L	0.1 U	0.1 U	0.1 U	
4,4'-DDT	UG/L	0.1 U	0.1 U	0 U	0.1 U
A-ENDOSULFAN	UG/L	0.05 U	0.05 U	0.05 U	
ALDRIN	UG/L	1.1 T	0.05 U	0 U	0.05 U
ALDRIN(2)	UG/L	0.05 U			
ALPHA-BHC	UG/L	0.05 U	0.05 U	0.05 U	

TABLE A-1.d.1
ABG SPRING WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SPR-A	03-SPR-B	03-SPR-C	03-SPR-C,D
ANALYTES	UNITS\ DATE	AUG/SEP	AUG/SEP	AUG/SEP	AUG/SEP
PESTICIDES(CONT'D..)					
ALPHA-CHLORDANE	UG/L	0.05 U	0.05 U	0.05 U	
ARAMITE	UG/L	10 U	10 U	10 U	
B-ENDOSULFAN	UG/L	0.1 U	0.1 U	0.1 U	
BETA-BHC	UG/L	0.05 U	0.05 U	0.05 U	
DELTA-BHC	UG/L	0.05 U	0.05 U	0.05 U	
DIALLATE	UG/L	1 U	1 U	1 U	
DIELDRIN	UG/L	0.1 U	0.1 U	0 U	0.1 U
DIMETHOATE	UG/L	0 U	0 U	0 U	
DISULFOTON	UG/L	50 U	50 U	50 U	
ENDOSULFAN SULFATE	UG/L	0.1 U	0.1 U	0.1 U	
ENDRIN	UG/L	0.1 U	0.1 U	0 U	0.1 U
ENDRIN ALDEHYDE	UG/L	0.1 U	0.1 U	0.1 U	
ETHYL PARATHION	UG/L	50 U	50 U	50 U	
FAMPHUR	UG/L	0 U	0 U	0 U	
GAMMA-BHC (LINDANE)	UG/L	0.05 U	0.05 U	0 U	0.05 U
GAMMA-CHLORDANE	UG/L	0.05 U	0.05 U	0.05 U	
HEPTACHLOR	UG/L	0.05 U	0.05 U	0 U	0.05 U
HEPTACHLOR EPOXIDE	UG/L	0.05 U	0.05 U	0.05 U	
ISODRIN	UG/L	0.1 U	0.1 U	0.1 U	
KEPONE	UG/L	1 U	1 U	1 U	
METHOXYCHLOR	UG/L	0.5 U	0.5 U	0.5 U	
METHYL METHANESULFONATE	UG/L	10 U	10 U	10 U	
METHYL PARATHION	UG/L	50 U	50 U	50 U	
PHORATE	UG/L	100 U	100 U	100 U	
PRONAMIDE	UG/L	10 U	10 U	10 U	
SULFOTEPP	UG/L	50 U	50 U	50 U	
THIONAZIN	UG/L	50 U	50 U	50 U	
TOXAPHENE	UG/L	5 U	5 U	5 U	
SVOCs					
1-NAPHTHYLAMINE	UG/L	10 U	10 U	10 U	
1,2-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	
1,2,4-TRICHLOROBENZENE	UG/L	10 U	10 U	0 U	10 U
1,2,4,5-TETRACHLOROBENZENE	UG/L	10 U	10 U	10 U	
1,3-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	
1,4-DICHLOROBENZENE	UG/L	10 U	10 U	0 U	10 U
1,4-NAPHTHOQUINONE	UG/L	10 U	10 U	10 U	
2-ACETYLAMINOFLUORENE	UG/L	100 U	100 U	100 U	
2-CHLORONAPHTHALENE	UG/L	10 U	10 U	10 U	

SAMPLE NAME		03-SPR-A	03-SPR-B	03-SPR-C	03-SPR-C,D
ANALYTES	UNITS\ DATE	AUG/SEP	AUG/SEP	AUG/SEP	AUG/SEP
SVOCs(CONT'D..)					
2-CHLOROPHENOL	UG/L	10 U	10 U	0 U	10 U
2-METHYL-4,6-DINITROPHENOL	UG/L	50 U	50 U	50 U	
2-METHYLNAPHTHALENE	UG/L	10 U	10 U	10 U	
2-METHYLPHENOL (O-CRESOL)	UG/L	10 U	10 U	10 U	
2-NAPHTHYLAMINE	UG/L	10 U	10 U	10 U	
2-NITROANILINE	UG/L	50 U	50 U	50 U	
2-NITROPHENOL	UG/L	10 U	10 U	10 U	
2-PICOLINE	UG/L	10 U	10 U	10 U	
2-SEC-BUTYL-4,6-DINITROPHENOL	UG/L	10 U	10 U	10 U	
2,3,4,6-TETRACHLOROPHENOL	UG/L	50 U	50 U	50 U	
2,4-DICHLOROPHENOL	UG/L	10 U	10 U	10 U	
2,4-DIMETHYLPHENOL	UG/L	10 U	10 U	10 U	
2,4-DINITROPHENOL	UG/L	50 UJ	50 U	50 U	
2,4,5-TRICHLOROPHENOL	UG/L	50 U	50 U	50 U	
2,4,6-TRICHLOROPHENOL	UG/L	10 U	10 U	10 U	
2,6-DICHLOROPHENOL	UG/L	10 U	10 U	10 U	
3-METHYLCHOLANTHRENE	UG/L	10 U	10 U	10 U	
3-NITROANILINE	UG/L	50 U	50 U	50 U	
3+4-METHYLPHENOL	UG/L	10 U	10 U	10 U	
3,3'-DICHLOROBENZIDINE	UG/L	20 U	20 U	20 U	
3,3-DIMETHYLBENZIDINE	UG/L	10 U	10 U	10 U	
4-AMINOBIPHENYL	UG/L	10 U	10 U	10 U	
4-BROMOPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	
4-CHLORO-3-METHYLPHENOL	UG/L	10 U	10 U	0 U	10 U
4-CHLOROANILINE	UG/L	10 U	10 U	10 U	
4-CHLOROPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	
4-NITROANILINE	UG/L	50 U	50 U	50 U	
4-NITROPHENOL	UG/L	50 U	50 U	0 U	50 U
4-NITROQUINOLINE-1-OXIDE	UG/L	0 UR	0 U	0 U	
4-PHENYLENEDIAMINE	UG/L	0 U	0 U	0 U	
5-NITRO-O-TOLUIDINE	UG/L	10 U	10 U	10 U	
7,12-DIMETHYLBENZ(A)ANTHRACENE	UG/L	10 U	10 U	10 U	
ACENAPHTHENE	UG/L	10 U	10 U	0 U	10 U
ACENAPHTHYLENE	UG/L	10 U	10 U	10 U	
ACETOPHENONE	UG/L	10 U	10 U	10 U	
ANILINE	UG/L	10 U	10 U	10 U	
ANTHRACENE	UG/L	10 U	10 U	10 U	
A,A-DIMETHYLPHENETHYLAMINE	UG/L	10 U	10 U	10 U	

TABLE A-1.d.1
ABG SPRING WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SPR-A	03-SPR-B	03-SPR-C	03-SPR-C,D
ANALYTES	UNITS\ DATE	AUG/SEP	AUG/SEP	AUG/SEP	AUG/SEP
SVOCs(CONT'D..)					
BENZO(A)ANTHRACENE	UG/L	10 U	10 U	10 U	
BENZO(A)PYRENE	UG/L	10 U	10 U	10 U	
BENZO(B)FLUORANTHENE	UG/L	10 U	10 U	10 U	
BENZO(G,H,I)PERYLENE	UG/L	10 U	10 U	10 U	
BENZO(K)FLUORANTHENE	UG/L	10 U	10 U	10 U	
BIS(2-CHLOROETHOXY)METHANE	UG/L	10 U	10 U	10 U	
BIS(2-CHLOROETHYL) ETHER	UG/L	10 U	10 U	10 U	
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 U	10 U	10 U	
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	10 U	3.7 J	10 U	
BIS(2-ETHYLHEXYL) PHTHALATE(2)	UG/L		10 U		
BUTYLBENZYLPHTHALATE	UG/L	10 U	10 U	10 U	
CHLOROBENZILATE	UG/L	0.1 U	0.1 U	0.1 U	
CHLOROPRENE	UG/L	5 U	5 U	5 U	
CHRYSENE	UG/L	10 U	10 U	10 U	
DIBENZOFURAN	UG/L	10 U	10 U	10 U	
DIBENZO(A,H)ANTHRACENE	UG/L	10 U	10 U	10 U	
DIETHYL PHTHALATE	UG/L	10 U	10 U	10 U	
DIMETHYL PHTHALATE	UG/L	10 U	10 U	10 U	
DI-N-BUTYL PHTHALATE	UG/L	10 U	10 U	10 U	
DI-N-OCTYL PHTHALATE	UG/L	10 U	10 U	10 U	
DIPHENYLAMINE	UG/L	10 U	10 U	10 U	
ETHYL METHACRYLATE	UG/L	20 U	20 U	20 U	
ETHYL METHANESULFONATE	UG/L	10 UJ	10 U	10 U	
FLUORANTHENE	UG/L	10 U	10 U	10 U	
FLUORENE	UG/L	10 U	10 U	10 U	
HEXACHLOROBENZENE	UG/L	10 U	10 U	10 U	
HEXACHLOROBUTADIENE	UG/L	10 U	10 U	10 U	
HEXACHLOROCYCLOPENTADIENE	UG/L	10 UJ	10 U	10 U	
HEXACHLOROETHANE	UG/L	10 U	10 U	10 U	
HEXACHLOROPHENE	UG/L	0 U	0 U	0 U	
HEXACHLOROPROPENE	UG/L	10 U	10 U	10 U	
INDENO(1,2,3-CD)PYRENE	UG/L	10 U	10 U	10 U	
ISOPHORONE	UG/L	10 U	10 U	10 U	
ISOSAFROLE	UG/L	20 U	20 U	20 U	
METHACRYLONITRILE	UG/L	5 UJ	5 U	5 U	
METHAPYRILENE	UG/L	10 U	10 U	10 U	
METHYL METHACRYLATE	UG/L	20 UJ	20 U	20 U	
NAPHTHALENE	UG/L	10 U	10 U	10 U	

SAMPLE NAME		03-SPR-A	03-SPR-B	03-SPR-C	03-SPR-C,D
ANALYTES	UNITS\ DATE	AUG/SEP	AUG/SEP	AUG/SEP	AUG/SEP
SVOCs(CONT'D..)					
N-NITROSODIETHYLAMINE	UG/L	10 U	10 U	10 U	
N-NITROSODIMETHYLAMINE	UG/L	10 U	10 U	10 U	
N-NITROSO-DI-N-BUTYLAMINE	UG/L	10 U	10 U	10 U	
N-NITROSO-DI-N-PROPYLAMINE	UG/L	10 U	10 U	0 U	10 U
N-NITROSODIPHENYLAMINE	UG/L	10 U	10 U	10 U	
N-NITROSOMETHYLETHYLAMINE	UG/L	10 U	10 U	10 U	
N-NITROSOMORPHOLINE	UG/L	10 U	10 U	10 U	
N-NITROSOPIPERIDINE	UG/L	10 U	10 U	10 U	
N-NITROSOPYRROLIDINE	UG/L	10 U	10 U	10 U	
O-TOLUIDINE	UG/L	10 U	10 U	10 U	
O,O,O-TRIETHYLPHOSPHOROTHIOATE	UG/L	10 U	10 U	10 U	
P-DIMETHYLAMINOAZOBENZENE	UG/L	10 U	10 U	10 U	
PENTACHLOROBENZENE	UG/L	10 U	10 U	10 U	
PENTACHLOROETHANE	UG/L	10 U	10 U	10 U	
PENTACHLORONITROBENZENE	UG/L	50 U	50 U	50 U	
PENTACHLOROPHENOL	UG/L	50 U	50 U	0 U	50 U
PHENACETIN	UG/L	10 U	10 U	10 U	
PHENANTHRENE	UG/L	10 U	10 U	10 U	
PHENOLS	UG/L	10 U	10 U	0 U	10 U
PROPIONITRILE	UG/L	5 UJ	5 U	5 U	
PYRENE	UG/L	10 U	10 U	0 U	10 U
PYRIDINE	UG/L	20 U	20 U	20 U	
SAFROLE	UG/L	10 U	10 U	10 U	
TRANS-1,4-DICHLORO-2-BUTENE	UG/L	5 U	5 U	5 U	
VOCs					
1,1-DICHLOROETHANE	UG/L	5 U	5 U	5 U	
1,1-DICHLOROETHENE	UG/L	5 U	5 U	0 U	5 U
1,1,1-TRICHLOROETHANE	UG/L	5 U	5 U	5 U	
1,1,1,2-TETRACHLOROETHANE	UG/L	5 U	5 U	5 U	
1,1,2-TRICHLOROETHANE	UG/L	5 U	5 U	5 U	
1,1,2,2-TETRACHLOROETHANE	UG/L	5 UJ	5 U	5 U	
1,2-DIBROMO-3-CHLOROPROPANE	UG/L	10 U	10 U	10 U	
1,2-DIBROMOETHANE	UG/L	10 U	10 U	10 U	
1,2-DICHLOROETHANE	UG/L	5 U	5 U	5 U	
1,2-DICHLOROETHENE(TOTAL)	UG/L	5 U	5 U	5 U	
1,2-DICHLOROPROPANE	UG/L	5 U	5 U	5 U	
1,2,3-TRICHLOROPROPANE	UG/L	5 U	5 U	5 U	
2-BUTANONE (MEK)	UG/L	10 UJ	10 U	10 U	

TABLE A-1.d.1
ABG SPRING WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SPR-A	03-SPR-B	03-SPR-C	03-SPR-C,D
ANALYTES	UNITS\ DATE	AUG/SEP	AUG/SEP	AUG/SEP	AUG/SEP
VOCs(CONT'D..)					
2-HEXANONE	UG/L	10 UJ	10 U	10 U	
4-METHYL-2-PENTANONE (MIBK)	UG/L	10 UJ	10 U	10 U	
ACETONE	UG/L	10 UJ	10 U	10 U	
ACETONITRILE	UG/L	200 UR	200 U	200 U	
ACROLEIN	UG/L	100 U	100 U	100 U	
ACRYLONITRILE	UG/L	100 U	100 U	100 U	
ALLYL CHLORIDE	UG/L	10 U	10 U	10 U	
BENZENE	UG/L	5 U	5 U	0 U	5 U
BENZYL ALCOHOL	UG/L	10 U	10 U	10 U	
BROMODICHLOROMETHANE	UG/L	5 U	5 U	5 U	
BROMOFORM	UG/L	5 U	5 U	5 U	
BROMOMETHANE (METHYL BROMIDE)	UG/L	10 UJ	10 U	10 U	
CARBON DISULFIDE	UG/L	5 U	5 U	5 U	
CARBON TETRACHLORIDE	UG/L	5 U	5 U	5 U	
CHLOROBENZENE	UG/L	5 U	5 U	0 U	5 U
CHLOROETHANE	UG/L	10 U	10 U	10 U	
CHLOROFORM	UG/L	5 U	5 U	5 U	
CHLOROMETHANE (METHYL CHLORIDE)	UG/L	10 UJ	10 U	10 U	
CIS-1,3-DICHLOROPROPENE	UG/L	5 U	5 U	5 U	
DIBROMOCHLOROMETHANE	UG/L	5 U	5 U	5 U	
DIBROMOMETHANE	UG/L	5 U	5 U	5 U	
DICHLORODIFLUOROMETHANE	UG/L	20 U	20 U	20 U	
ETHYLBENZENE	UG/L	5 U	5 U	5 U	
IODOMETHANE	UG/L	5 UJ	5 U	5 U	
ISOBUTYL ALCOHOL (ISOBUTANOL)	UG/L	200 UR	200 U	200 U	
METHYLENE CHLORIDE	UG/L	5 U	3.4 J	1.6 J	
STYRENE	UG/L	5 U	5 U	5 U	
TETRACHLOROETHENE	UG/L	5 U	5 U	5 U	
TOLUENE	UG/L	5 U	5 U	0 U	5 U
TRANS-1,3-DICHLOROPROPENE	UG/L	5 U	5 U	5 U	
TRICHLOROETHENE	UG/L	5 U	5 U	0 U	5 U
TRICHLOROFLUOROMETHANE	UG/L	5 U	5 U	5 U	
VINYL ACETATE	UG/L	10 U	10 U	10 U	
VINYL CHLORIDE	UG/L	10 UJ	10 U	10 U	
XYLENE, TOTAL	UG/L	2.3 J	5 U	2.4 J	
WATER QUALITY PARAMETER					
NITRATE NITROGEN	MG/L	0.78	0.63	0	0.59
SULFIDE, TOTAL	MG/L	0.05 U	0.05 U	0 U	0.05 U

TABLE A-2.a.1
ORR SURFACE/SUBSURFACE SOIL SAMPLE RESULTS
1990 WES LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		01A-90-1	01A-90-2	01A-90-3	02-90-1	02-90-2	02-90-3	03-90-1	03-90-2	03-90-3	04-90-1	04-90-2	04-90-3	05-90-1
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
EXPLOSIVES														
1,3-DINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
1,3,5-TRINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	0.159 J	<0.250 U	<0.250 U	0.183 J
2,4-DINITROTOLUENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	0.199 J	<0.250 U	<0.250 U	0.433
2,6-DINITROTOLUENE	MG/KG	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U
HMX	MG/KG	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U
RDX	MG/KG	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U

SAMPLE NAME		05-90-2	05-90-3	06-90-1	06-90-2	06-90-3	07-90-1	07-90-2	07-90-3	08-90-1	08-90-2	09-90-1	09-90-2	10-90-1
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
EXPLOSIVES														
1,3-DINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
1,3,5-TRINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
2,4-DINITROTOLUENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	1.70	<0.250 U	<0.250 U	<0.250 U	<0.250 U
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.250 U	<0.250 U	0.147 J	<0.250 U	<0.250 U	<0.250 U	<0.250 U	[illegible]	<0.250 U	3.08	<0.250 U	<0.250 U	<0.250 U
2,6-DINITROTOLUENE	MG/KG	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	[illegible]							
HMX	MG/KG	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20				<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U
RDX	MG/KG	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00				<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65				0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U

RRSOSUM

SAMPLE NAME		10-90-2	11-90-1	11-90-2	11-90-3	12-90-				A-90-5	02-90-4	02-90-5	03-90-4	03-90-5
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surfac				bsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.
EXPLOSIVES														
1,3-DINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250				250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
1,3,5-TRINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250				250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
2,4-DINITROTOLUENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250				250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250				250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
2,6-DINITROTOLUENE	MG/KG		<0.260 U	<0.260 U	<0.260 U					260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U
HMX	MG/KG	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U				20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U
RDX	MG/KG	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U				1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U				<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U

SAMPLE NAME		04-90-4	04-90-5	05-90-4	06-90-4	07-90-4	07-90-5	07-90-6	07-90-7	11-90-4	11-90-5	11-90-6	12-90-4
ANALYTES	UNITS	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.
EXPLOSIVES													
1,3-DINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
1,3,5-TRINITROBENZENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
2,4-DINITROTOLUENE	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
2,4,6-TRINITROTOLUENE (TNT)	MG/KG	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U	<0.250 U
2,6-DINITROTOLUENE	MG/KG	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	<0.260 U	
HMX	MG/KG	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U	<2.20 U
RDX	MG/KG	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U	<1.00 U
TETRYL	MG/KG	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U	<0.65 U

TABLE A-2.d.1
ORR GROUND WATER SAMPLE RESULTS
1990 - 1992 WES LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK
SAMPLE NAME		06C09	06C09	06C09	06C09	06C10	06C10	06C10	06C10	06C11	06C11	06C11	06C11	06C12
	UNITS\DATE	90-11	91-06	91-11	92-04	91-03	91-06	91-11	92-04	91-03	91-06	91-11	92-04	91-03
EXPLOSIVES														
1,3,5-TRINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,6-DINITROTOLUENE	MG/L	<0.0097 U	<0.010 U	<0.020 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.020 U	<0.010 U
DINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
HMX	MG/L	<0.020 U	0.019 J	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
RDX	MG/L	0.017 J	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
TETRYL	MG/L	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK
SAMPLE NAME		06C12	06C12	06C12	06C13	06C13	06C13	06C13	06C14	06C14	06C14	06C14,D	06C15	06C15
	UNITS\DATE	91-06	91-11	92-04	90-11	91-06	91-11	92-04	90-11	91-06	92-04	91-06	90-11	91-06
EXPLOSIVES														
1,3,5-TRINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	0.012 J
2,6-DINITROTOLUENE	MG/L	<0.010 U	<0.020 U	<0.020 U	<0.0098 U	<0.010 U	<0.020 U	<0.020 U	<0.0096 U	<0.010 U	<0.020 U		<0.012 U	<0.010 U
DINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
HMX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
RDX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020	<0.020 U	<0.020	<0.020 U	<0.020
TETRYL	MG/L	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.020 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK
SAMPLE NAME		06C15	06C15	06C16	06C16	06C16	06C16	06C17	06C17	06C17	06C17	06C18	06C18	06C18
	UNITS\DATE	91-11	92-04	90-11	91-06	91-11	92-04	90-11	91-06	91-11	92-04	90-11	91-06	91-11
EXPLOSIVES														
1,3,5-TRINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,6-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.0098 U	<0.010 U	<0.020 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.020 U	<0.0097 U	<0.010 U	<0.020 U
DINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
HMX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
RDX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
TETRYL	MG/L	<0.050 U	<0.050 U	<0.020 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U

TABLE A-2.d.1
ORR GROUND WATER SAMPLE RESULTS
1990 - 1992 WES LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	GOLCON	GOLCON	GOLCON	GOLCON	GOLCON	GOLCON	GOLCON	SURF	SURF	SURF	SURF	SURF
SAMPLE NAME		06C18	06-21	06-21	06-21	06C16P3	06C16P3	06C16P3	06C16P3	06-14A	06-14A	06-14A	06-15	06-15
	UNITS\DATE	92-04	90-11	91-06	92-04	90-11	91-06	91-11	92-04	91-06	91-11	92-04	90-11	91-06
EXPLOSIVES														
1,3,5-TRINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,6-DINITROTOLUENE	MG/L	<0.020 U	<0.011 U	<0.010 U	<0.020 U	<0.011 U	<0.010 U	<0.020 U	<0.020 U	<0.010 U	<0.020 U	<0.020 U	<0.0099 U	<0.010 U
DINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
HMX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
RDX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
TETRYL	MG/L	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.020 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U

AQUIFER		SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF
SAMPLE NAME		06-15	06-16	06-16	06-16	06-16	06-17	06-17	06-17	06-18	06-18	06-18	06-18	06-19
	UNITS\DATE	92-04	90-11	91-06	91-11	92-04	90-11	91-06	92-04	90-11	91-06	91-11	92-04	91-06
EXPLOSIVES														
1,3,5-TRINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	0.014 J	0.015 J	0.016 J	0.010 J	<0.020 U
2,6-DINITROTOLUENE	MG/L	<0.020 U	<0.011 U	<0.010 U	<0.020 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.011 U	<0.010 U	<0.020 U	<0.020 U	<0.010 U
DINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
HMX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
RDX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
TETRYL	MG/L	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U

AQUIFER		SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF
SAMPLE NAME		06-19	06-19	06-20	06-20	06-20	06-20	06-22	06-22	06-22	06-22	06-23	06-23	06-23
	UNITS\DATE	91-11	92-04	90-11	91-06	91-11	92-04	90-11	91-06	91-11	92-04	90-11	91-06	91-11
EXPLOSIVES														
1,3,5-TRINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	0.148	0.131	0.098	0.088	<0.020 U	<0.020 U	<0.020 U
2,6-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.0099 U	<0.010 U	<0.020 U	<0.020 U	<0.0098 U	<0.010 U	<0.020 U	<0.020 U	<0.0099 U	<0.010 U	<0.020 U
DINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
HMX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
RDX	MG/L	<0.020 U	<0.020 U	<0.020 U	0.034	0.035	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
TETRYL	MG/L	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U

TABLE A-2.d.1
ORR GROUND WATER SAMPLE RESULTS
1990 - 1992 WES LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF
SAMPLE NAME		06-23	06C10P2	06C10P2	06C10P2	06C10P2	06C11P2	06C11P2	06C11P2	06C11P2	06C12P2	06C12P2	06C12P2	06C12P2
	UNITS\DATE	92-04	91-03	91-06	91-11	92-04	91-03	91-06	91-11	92-04	91-03	91-06	91-11	92-04
EXPLOSIVES														
1,3,5-TRINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,6-DINITROTOLUENE	MG/L	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.020 U		<0.010 U	<0.020 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.020 U
DINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
HMX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
RDX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
TETRYL	MG/L	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U

AQUIFER		SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF
SAMPLE NAME		06C13P2	06C13P2	06C13P2	06C13P2	06C14P2	06C14P2	06C14P2	06C15P2	06C15P2	06C15P2	06C15P2	06C16P2	06C16P2
	UNITS\DATE	90-11	91-06	91-11	92-04	90-11	91-11	92-04	90-11	91-06	91-11	92-04	90-11	91-06
EXPLOSIVES														
1,3,5-TRINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,6-DINITROTOLUENE	MG/L	<0.0099 U	<0.010 U	<0.020 U	<0.020 U	<0.0095 U	<0.020 U	<0.020 U	<0.0096 U	<0.010 U	<0.020 U	<0.020 U	<0.010 U	<0.010 U
DINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
HMX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
RDX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
TETRYL	MG/L	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.020 U	<0.050 U

AQUIFER		SURF	SURF	SURF	SURF	SURF	SURF
SAMPLE NAME		06C16P2	06C16P2	06C18P2	06C18P2	06C18P2	06C18P2
	UNITS\DATE	91-11	92-04	90-11	91-06	91-11	92-04
EXPLOSIVES							
1,3,5-TRINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,6-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.020 U
DINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
HMX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
RDX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
TETRYL	MG/L	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BVR BND	BVR BND	BVR BND	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK
SAMPLE NAME	UNITS	03C03	03C08A	03C09	03B10	03C02P2	03C03P2	03C03P2,D	03C04	03C05	03C06	03C07	03C08AP2	03C09P2	03C10
EXPLOSIVES															
1,3-DINITROBENZENE	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	8 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,3-DINITROBENZENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	2 U	10 U	10 U	10 U	10 U	10 U
1,3,5-TRINITROBENZENE	UG/L	2 U	2 U	2 U	2 U	2 U	4.2	8 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,3,5-TRINITROBENZENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	2 U	10 U	10 UR	10 UR	10 U	10 U
2,4-DINITROTOLUENE	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	8 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,4-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	2 U	10 U	10 U	10 UJ	10 U	10 U
2,4,6-TRINITROTOLUENE (TNT)	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	8 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,6-DINITROTOLUENE	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	8 U	2 U	2 U	0.2 U	2 U	2 U	2 U	2 U
2,6-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	2 U	10 U	10 U	10 U	10 U	10 U
HMX	UG/L	2 U	2 U	2 U	2 U	18 V	33	34	2 U	2 U	3	3.6	33 V	2 U	3.5 V
HMX(2)	UG/L						37 V					4.2			
NITROBENZENE	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	8 U	2 U	2 U	0.2 U	2 U	2 U	2 U	2 U
NITROBENZENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	2 U	10 U	10 U	10 UJ	10 U	10 U
RDX	UG/L	2 U	2 U	2 U	2 U	26	310	300 r	2 U	2 U	0.2 U	22	140	71	60
RDX(2)	UG/L													81	
TETRYL	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	8 U	2 U	2 U	0.005 U	2 U	2 U	2 U	2 U
INORGANICS															
ALUMINUM, DISSOLVED	MG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U		0.2 U	0.2 U	0.0081	0.2 U	0.2 U	0.2 U	0.2 U
ALUMINUM, TOTAL	MG/L	0.2 U	0.2 U	0.2 U	22.4	0.2 U	0.2 U		0.2 U	3	0.1 U	0.24	0.2 U	0.2 U	0.55
ANTIMONY, DISSOLVED	MG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U		0.2 U	0.2 U	0.1 U	0.2 U	0.2 U	0.2 U	0.2 U
ANTIMONY, TOTAL	MG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U		0.2 U	0.2 U	0.002 U	0.2 U	0.2 U	0.2 U	0.2 U
ARSENIC, DISSOLVED	MG/L	0.005 U	0.0074	0.0058	0.005 U	0.005 U	0.005 U		0.005 U	0.005 U	0.002 U	0.005 U	0.005 U	0.005 U	0.005 U
ARSENIC, TOTAL	MG/L	0.005 U	0.0098	0.0063	0.036	0.005 U	0.005 U		0.005 U	0.0081	0.005 U	0.005 U	0.005 U	0.005 U	0.0054
BARIUM, DISSOLVED	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	0.005 U	0.1 U	0.1 U	0.1 U	0.1 U
BARIUM, TOTAL	MG/L	0.1 U	0.1 U	0.1 U	0.41	0.1 U	0.1 U		0.1 U	0.1 U	0.03 U	0.1 U	0.1 U	0.1 U	0.1 U
BERYLLIUM, DISSOLVED	MG/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U		0.002 U	0.002 U	0.033	0.002 U	0.002 U	0.002 U	0.002 U
BERYLLIUM, TOTAL	MG/L	0.002 U	0.002 U	0.002 U	0.0028	0.002 U	0.002 U		0.002 U	0.002 U	0.04 U	0.002 U	0.002 U	0.002 U	0.002 U
CADMIUM, DISSOLVED	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U		0.005 U	0.005 U	0.04 U	0.005 U	0.005 U	0.005 U	0.005 U
CADMIUM, TOTAL	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U		0.005 U	0.005 U	0.03 U	0.005 U	0.005 U	0.005 U	0.005 U
CHROMIUM, DISSOLVED	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U		0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
CHROMIUM, TOTAL	MG/L	0.03 U	0.03 U	0.03 U	0.036	0.03 U	0.03 U		0.03 U	0.033	0.01 U	0.03 U	0.03 U	0.03 U	0.03 U
COBALT, DISSOLVED	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U		0.04 U	0.04 U	0.047	0.04 U	0.04 U	0.04 U	0.04 U
COBALT, TOTAL	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U		0.04 U	0.04 U	15.7	0.04 U	0.04 U	0.04 U	0.04 U
COPPER, DISSOLVED	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U		0.03 U	0.03 U	0.005 U	0.03 U	0.03 U	0.03 U	0.03 U
COPPER, TOTAL	MG/L	0.03 U	0.03 U	0.03 U	0.075	0.03 U	0.03 U		0.03 U	0.03 U	0.018	0.03 U	0.03 U	0.03 U	0.03 U
CYANIDE	MG/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
IRON, DISSOLVED	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.07	0.071		0.21	0.047	1.2	0.12	0.1	0.07	0.094
IRON, TOTAL	MG/L	0.04 U	0.04 U	0.04 U	58.6	0.18	0.072		0.5	15.7	0.0002 U	0.78	0.72	0.37	6.9
LEAD, DISSOLVED	MG/L	0.01 U	0.01 U	0.005 U	0.005 U	0.01 U	0.005 U		0.02 U	0.005 U	0.00022	0.02 U	0.01 UJ	0.005 U	0.005 U
LEAD, TOTAL	MG/L	0.005 U	0.005 U	0.005 U	0.06	0.005 U	0.005 U		0.0078	0.018	0.04 U	0.011	0.0076	0.005 U	0.005 U
MANGANESE, DISSOLVED	MG/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.089		0.12	0.01 U	0.04 U	0.013	0.01 U	0.01 U	0.017
MANGANESE, TOTAL	MG/L	0.01 U	0.01 U	0.01 U	3.8	0.015	0.094		0.11	1.2	0.01 U	0.22	0.023	0.11	0.96
MERCURY, DISSOLVED	MG/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U		0.0002 U	0.0002 U	0.01 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BVR BND	BVR BND	BVR BND	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK
SAMPLE NAME	UNITS	03C03	03C08A	03C09	03B10	03C02P2	03C03P2	03C03P2,D	03C04	03C05	03C06	03C07	03C08AP2	03C09P2	03C10
INORGANICS(CONT'D..)															
MERCURY, TOTAL	MG/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U		0.0002 U	0.00022	0.03 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
NICKEL, DISSOLVED	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U		0.04 U	0.04 U	0.03 U	0.04 U	0.04 U	0.04 U	0.04 U
NICKEL, TOTAL	MG/L	0.04 U	0.04 U	0.04 U	0.099	0.04 U	0.04 U		0.04 U	0.04 U	0.005 U	0.04 U	0.04 U	0.04 U	0.04 U
SELENIUM, DISSOLVED	MG/L	0.01 U	0.01 U	0.01 U	0.005 U	0.01 U	0.01 U		0.01 U	0.01 U	0.01 U	0.005 U	0.005 U	0.01 U	0.01 U
SELENIUM, TOTAL	MG/L	0.005 U	0.005 U	0.005 U	0.01 U	0.01 U	0.01 U		0.005 U	0.01 U	0.1 U	0.005 U	0.005 U	0.01 U	0.01 U
SILVER, DISSOLVED	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U		0.03 U	0.03 U	0.1 U	0.03 U	0.03 U	0.03 U	0.03 U
SILVER, TOTAL	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U		0.03 U	0.03 U	0.04 U	0.03 U	0.03 U	0.03 U	0.03 U
THALLIUM, DISSOLVED	MG/L	0.02 U	0.01 U	0.02 U	0.01 U	0.01 U	0.01 U		0.02 U	0.005 U	0.04 U	0.005 U	0.005 UJ	0.01 U	0.005 U
THALLIUM, TOTAL	MG/L	0.025 U	0.01 U	0.025 U	0.005 U	0.025 U	0.025 U		0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.02 U	0.01 U
TIN, DISSOLVED	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	0.11	0.1 U	0.1 U	0.1 U	0.1 U
TIN, TOTAL	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	1 U	0.1 U	0.1 U	0.1 U	0.1 U
VANADIUM, DISSOLVED	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U		0.04 U	0.04 U	1 U	0.04 U	0.04 U	0.04 U	0.04 U
VANADIUM, TOTAL	MG/L	0.04 U	0.04 U	0.04 U	0.057	0.04 U	0.04 U		0.04 U	0.04 U	1 U	0.04 U	0.04 U	0.04 U	0.04 U
ZINC, DISSOLVED	MG/L	0.01 U	0.01 U	0.01 U	0.015	0.01	0.01 U		0.63	0.01 U	1 U	0.01 U	0.013	0.023	0.01 U
ZINC, TOTAL	MG/L	0.01	0.015	0.01	0.46 B	0.026	0.01 U		0.04	0.11	1 U	0.025	0.032	0.01 U	0.027
PCBs															
PCB-1016	UG/L	1 U	1 U	1 U	1 U	1 U	1 U		1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1221	UG/L	1 U	1 U	1 U	1 U	1 U	1 U		1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1232	UG/L	1 U	1 U	1 U	1 U	1 U	1 U		1 U	1 U	500 U	1 U	1 U	1 U	1 U
PCB-1242	UG/L	1 U	1 U	1 U	1 U	1 U	1 U		1 U	1 U	1.2 U	1 U	1 U	1 U	1 U
PCB-1248	UG/L	1 U	1 U	1 U	1 U	1 U	1 U		1 U	1 U	0.2 U	1 U	1 U	1 U	1 U
PCB-1254	UG/L	1 U	1 U	1 U	1 U	1 U	1 U		1 U	1 U	0.17 U	1 U	1 U	1 U	1 U
PCB-1260	UG/L	1 U	1 U	1 U	1 U	1 U	1 U		1 U	1 U	0.1 U	1 U	1 U	1 U	1 U
PESTICIDES															
1,4-DIOXANE	UG/L	500 U	500 U	500 UR	500 U	500 U	500 U		500 U	500 U	0.1 U	500 UJ	500 U	500 UR	500 U
2,4-D	UG/L	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U		1.2 U	1.2 U	0.1 U	1.2 U	1.2 U	1.2 U	1.2 U
2,4,5-T	UG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U		0.2 U	0.2 U	0.05 U	0.2 U	0.2 U	0.2 U	0.2 U
2,4,5-TP	UG/L	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U		0.17 U	0.17 U	0.05 U	0.17 U	0.17 U	0.17 U	0.17 U
4,4'-DDD	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	0.05 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	0.05 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDT	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	10 U	0.1 U	0.1 U	0.1 U	0.1 U
A-ENDOSULFAN	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.1 U	0.05 U	0.05 U	0.05 U	0.05 U
ALDRIN	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.05 U	0.18 T	1.2 T	0.05 U	0.05 U
ALDRIN(2)	UG/L											0.05 U	0.05 U		
ALPHA-BHC	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
ALPHA-CHLORDANE	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	1 U	0.05 U	0.05 U	0.05 U	0.05 U
ARAMITE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	0.1 U	10 U	10 U	10 U	10 U
B-ENDOSULFAN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	0 U	0.1 U	0.1 U	0.1 U	0.1 U
BETA-BHC	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	50 U	0.05 U	0.05 U	0.05 U	0.05 U
DELTA-BHC	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.1 U	0.05 U	0.05 U	0.05 U	0.05 U
DIALLATE	UG/L	1 U	1 U	1 U	1 U	1 U	1 U		1 U	1 U	0.1 U	1 U	1 U	1 U	1 U
DIELDRIN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
DIMETHOATE	UG/L	0 U	0 U	0 U	0 U	0 U	0 U		0 U	0 U	50 U	0 U	0 U	0 U	0 U

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BVR BND	BVR BND	BVR BND	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK
SAMPLE NAME	UNITS	03C03	03C08A	03C09	03B10	03C02P2	03C03P2	03C03P2,D	03C04	03C05	03C06	03C07	03C08AP2	03C09P2	03C10
PESTICIDES(CONT'D..)															
DISULFOTON	UG/L	50 U	50 U	50 UJ	50 U	50 U	50 U		100 U	50 U	0 U	50 U	50 U	50 UJ	50 U
ENDOSULFAN SULFATE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	0.05 U	0.1 U	0.1 U	0.1 U	0.1 U
ENDRIN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	0.05 U	0.1 U	0.1 U	0.1 U	0.1 U
ENDRIN ALDEHYDE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	0.05 U	0.1 U	0.1 U	0.1 U	0.1 U
ENDRIN(2)	UG/L														
ETHYL PARATHION	UG/L	50 U	50 U	50 U	50 U	50 U	50 U		100 U	50 U	0.05 U	50 U	50 U	50 U	50 U
FAMPHUR	UG/L	0 U	0 U	0 UJ	0 U	0 U	0 U		0 U	0 U	0.1 U	0 U	0 U	0 UJ	0 U
GAMMA-BHC (LINDANE)	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	1 U	0.05 U	0.05 U	0.05 U	0.05 U
GAMMA-CHLORDANE	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	0.5 U	0.05 U	0.05 U	0.05 U	0.05 U
HEPTACHLOR	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		0.05 U	0.05 U	10 U	0.05 U	0.05 U	0.05 U	0.05 U
HEPTACHLOR EPOXIDE	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U		0.078	0.05 U	50 U	0.05 U	0.05 U	0.05 U	0.05 U
HEPTACHLOR EPOXIDE(2)	UG/L								0.05 U						
ISODRIN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	100 U	0.1 U	0.1 U	0.1 U	0.1 U
KEPONE	UG/L	1 U	1 U	1 U	1 U	1 U	1 U		1 U	1 U	10 U	1 U	1 U	1 U	1 U
METHOXYCHLOR	UG/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U		0.5 U	0.5 U	50 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYL METHANESULFONATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	50 U	10 UJ	10 U	10 U	10 U
METHYL PARATHION	UG/L	50 U	50 U	50 U	50 U	50 U	50 U		100 U	50 U	5 U	50 UJ	50 U	50 U	50 U
PHORATE	UG/L	100 U	100 U	100 UJ	100 U	100 U	100 U		200 U	100 U	10 U	100 U	100 U	100 UJ	100 U
PRONAMIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
SULFOTEPP	UG/L	50 U	50 U	50 U	50 U	50 U	50 U		100 U	50 U	10 U	50 U	50 U	50 U	50 U
THIONAZIN	UG/L	50 U	50 U	50 U	50 U	50 U	50 U		100 U	50 U	10 U	50 U	50 U	50 U	50 U
TOXAPHENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	10 U	5 U	5 U	5 U	5 U
SVOCs															
1-NAPHTHYLAMINE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 UJ	10 U
1,2-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-TRICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	0 U	10 U		20 U	10 U	100 U	10 U	10 U	10 U	10 U
1,2,4,5-TETRACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	0 U	10 U		20 U	10 U	50 U	10 U	10 U	10 U	10 U
1,4-NAPHTHOQUINONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
2-ACETYLAMINOFLUORENE	UG/L	100 U	100 U	100 UJ	100 U	100 U	100 U		200 U	100 U	10 U	100 U	100 U	100 UJ	100 U
2-CHLORONAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
2-CHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	0 U	10 U		20 U	10 U	50 U	10 U	10 U	10 U	10 U
2-METHYL-4,6-DINITROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U		100 U	50 U	10 U	50 U	50 UJ	50 U	50 U
2-METHYLNAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
2-METHYLPHENOL (O-CRESOL)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
2-NAPHTHYLAMINE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		20 U	10 U	50 U	10 U	10 U	10 UJ	10 U
2-NITROANILINE	UG/L	50 U	50 U	50 U	50 U	50 U	50 U		100 U	50 U	10 U	50 U	50 U	50 U	50 U
2-NITROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
2-PICOLINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	50 U	10 U	10 U	10 U	10 U
2-SEC-BUTYL-4,6-DINITROPHENOL	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		20 U	10 U	50 U	10 UR	10 UJ	10 UJ	10 U
2,3,4,6-TETRACHLOROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U		100 U	50 U	10 U	50 UJ	50 U	50 U	50 U
2,4-DICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BVR BND	BVR BND	BVR BND	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK
SAMPLE NAME	UNITS	03C03	03C08A	03C09	03B10	03C02P2	03C03P2	03C03P2,D	03C04	03C05	03C06	03C07	03C08AP2	03C09P2	03C10
SVOCs(CONT'D..)															
2,4-DIMETHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DINITROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U		100 U	50 U	50 U	50 U	50 U	50 U	50 U
2,4,5-TRICHLOROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U		100 U	50 U	10 U	50 U	50 U	50 U	50 U
2,4,6-TRICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	20 U	10 U	10 U	10 U	10 U
2,6-DICHLOROPHENOL	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 UJ	10 U
3-METHYLCHOLANTHRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
3-NITROANILINE	UG/L	50 U	50 U	50 UJ	50 U	50 U	50 U		100 U	50 U	10 U	50 U	50 U	50 UJ	50 U
3+4-METHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-DICHLOROBENZIDINE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U		40 U	20 U	10 U	20 U	20 U	20 U	20 U
3,3-DIMETHYLBENZIDINE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 UJ	10 U
4-AMINOBIPHENYL	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		20 U	10 U	50 U	10 U	10 U	10 UJ	10 U
4-BROMOPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	50 U	10 U	10 U	10 U	10 U
4-CHLORO-3-METHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	0 U	10 U		20 U	10 U	0 U	10 U	10 U	10 U	10 U
4-CHLOROANILINE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		20 U	10 U	0 U	10 U	10 U	10 UJ	10 U
4-CHLOROPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
4-NITROANILINE	UG/L	50 U	50 U	50 UJ	50 U	50 U	50 U		100 U	50 U	10 U	50 U	50 U	50 UJ	50 U
4-NITROPHENOL	UG/L	50 U	50 U	50 U	50 U	0 U	50 U		100 U	50 U	10 U	50 U	50 UJ	50 U	50 U
4-NITROQUINOLINE-1-OXIDE	UG/L	0 U	0 U	0 UJ	0 U	0 U	0 U		0 U	0 U	10 U	0 UR	0 UR	0 UJ	0 U
4-PHENYLENEDIAMINE	UG/L	0 U	0 U	0 UJ	0 U	0 U	0 U		0 U	0 U	10 U	0 U	0 U	0 UJ	0 U
5-NITRO-O-TOLUIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
7,12-DIMETHYLBENZ(A)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
ACENAPHTHENE	UG/L	10 U	10 U	10 U	10 U	0 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
ACENAPHTHYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
ACETOPHENONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
ANILINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
A,A-DIMETHYLPHENETHYLAMINE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		20 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U
BENZO(A)ANTHRACENE	UG/L	1.2 J	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(A)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(B)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 UJ	10 U	10 U	10 U
BENZO(G,H,I)PERYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	6.6 J	10 U	10 U	10 U	10 U
BENZO(K)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHOXY)METHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	0.1 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHYL) ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	5 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	2.2 J	10 U	10 U	10 U	10 U	10 U		34	6.6 J	10 U	15	10 UJ	10 U	1.2 J
BUTYLBENZYLPHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROBENZILATE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U		0.1 U	0.1 U	10 U	0.1 U	0.1 U	0.1 U	0.1 U
CHLOROPRENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	10 U	5 U	5 U	5 U	5 U
CHRYSENE	UG/L	1.2 J	10 U	10 UJ	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 UJ	10 U
DIBENZOFURAN	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 UJ	10 U	10 U
DIBENZO(A,H)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
DIETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	20 U	10 U	10 U	10 U	10 U

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BVR BND	BVR BND	BVR BND	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK
SAMPLE NAME	UNITS	03C03	03C08A	03C09	03B10	03C02P2	03C03P2	03C03P2,D	03C04	03C05	03C06	03C07	03C08AP2	03C09P2	03C10
SVOCs(CONT'D..)															
DIMETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
DI-N-BUTYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
DI-N-OCTYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
DIPHENYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
ETHYL METHACRYLATE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U		20 U	20 U	10 U	20 U	20 U	20 U	20 U
ETHYL METHANESULFONATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 UJ	10 U	10 U	10 U
FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
FLUORENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	0 U	10 U	10 U	10 U	10 U
HEXACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBUTADIENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROCYCLOPENTADIENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	20 U	10 U	10 U	10 U	10 U
HEXACHLOROPHENE	UG/L	0 U	0 U	0 U	0 U	0 U	0 U		0 U	0 U	5 U	0 U	0 U	0 U	0 U
HEXACHLOROPROPENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
INDENO(1,2,3-CD)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	20 U	10 U	10 U	10 U	10 U
ISOPHORONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
ISOSAFROLE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U		40 U	20 U	10 U	20 U	20 U	20 U	20 U
METHACRYLONITRILE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	10 U	5 U	5 U	5 U	5 U
METHAPYRILENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 UJ	10 U	10 U
METHYL METHACRYLATE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U		20 U	20 U	10 U	20 U	20 U	20 U	20 U
NAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSODIETHYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 UJ	10 U	10 U	10 U
N-NITROSODIMETHYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSO-DI-N-BUTYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSO-DI-N-PROPYLAMINE	UG/L	10 U	10 U	10 U	10 U	0 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSODIPHENYLAMINE	UG/L	1.4 J	10 U	1.5 J	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	1.5 J	1.4 J
N-NITROSOMETHYLETHYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSOMORPHOLINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSOPIPERIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSOPYRROLIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
O-TOLUIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	50 U	10 U	10 U	10 U	10 U
O,O,O-TRIETHYLPHOSPHOROTHIOATE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		20 U	10 U	50 U	10 U	10 U	10 UJ	10 U
P-DIMETHYLAMINOAZOBENZENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 UJ	10 U
PENTACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
PENTACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
PENTACHLORONITROBENZENE	UG/L	50 U	50 U	50 U	50 U	50 U	50 U		100 U	50 U	5 U	50 UR	50 U	50 U	50 U
PENTACHLOROPHENOL	UG/L	50 U	50 U	50 U	50 U	0 U	50 U		100 U	50 U	10 U	50 U	50 U	50 U	50 U
PHENACETIN	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		20 U	10 U	20 U	10 UJ	10 U	10 UJ	10 U
PHENANTHRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	10 U	10 U	10 U	10 U	10 U
PHENOLS	UG/L	10 U	10 U	10 U	10 U	0 U	10 U		20 U	10 U	5 U	10 U	10 U	10 U	10 U
PROPIONITRILE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U
PYRENE	UG/L	10 U	10 U	10 U	10 U	0 U	10 U		20 U	10 U	5 U	10 U	10 U	10 U	10 U
PYRIDINE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U		40 U	20 U	5 U	20 U	20 U	20 U	20 U

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BVR BND	BVR BND	BVR BND	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK
SAMPLE NAME	UNITS	03C03	03C08A	03C09	03B10	03C02P2	03C03P2	03C03P2,D	03C04	03C05	03C06	03C07	03C08AP2	03C09P2	03C10
SVOCs(CONT'D..)															
SAFROLE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		20 U	10 U	5 U	10 U	10 U	10 UJ	10 U
TRANS-1,4-DICHLORO-2-BUTENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	5 U	5 UJ	5 UJ	5 U	5 U
VOCs															
1,1-DICHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-DICHLOROETHENE	UG/L	5 U	5 U	5 U	5 U	0 U	5 U		5 U	5 U	10 U	5 U	5 U	5 U	5 U
1,1,1-TRICHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	10 U	5 U	5 U	5 U	5 U
1,1,1,2-TETRACHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2-TRICHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2,2-TETRACHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-DIBROMO-3-CHLOROPROPANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	5 U	10 U	10 U	10 U	10 U
1,2-DIBROMOETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	9.4		5 U	5 U	10 U	5 U	5 U	7.3	18
1,2-DICHLOROETHENE(TOTAL)	UG/L	5 U	5 U	5 U	5 U	5 U	34		5 U	5 U	10 U	5 U	5 U	5 U	5 U
1,2-DICHLOROPROPANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	10 U	5 U	5 U	5 U	5 U
1,2,3-TRICHLOROPROPANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	200 U	5 U	5 U	5 U	5 U
2-BUTANONE (MEK)	UG/L	10 U	10 U	10 U	10 U	23	10 U		10 U	10 U	100 U	21	10 U	10 U	10 U
2-HEXANONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	100 U	10 U	10 UJ	10 U	10 U
4-METHYL-2-PENTANONE (MIBK)	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U
ACETONE	UG/L	10 U	10 U	10 U	10 U	10 U	4.1 J		10 U	10 U	5 U	6.6 J	10 UJ	10 U	10 U
ACETONITRILE	UG/L	200 U	200 U	200 U	200 U	200 U	200 U		200 U	200 U	10 U	200 U	200 U	200 U	200 U
ACROLEIN	UG/L	100 U	100 U	100 UJ	100 U	100 U	100 U		100 U	100 U	5 U	100 U	100 UJ	100 UJ	100 U
ACRYLONITRILE	UG/L	100 U	100 U	100 U	100 U	100 U	100 U		100 U	100 U	5 U	100 U	100 U	100 U	100 U
ALLYL CHLORIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZENE	UG/L	5 U	5 U	5 U	5 U	0 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U
BENZYL ALCOHOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		20 U	10 U	5 U	10 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U
BROMOFORM	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	10 U	5 U	5 U	5 U	5 U
BROMOMETHANE (METHYL BROMIDE)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	5 U	10 U	10 U	10 U	10 U
CARBON DISULFIDE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	10 U	5 U	5 U	5 U	5 U
CARBON TETRACHLORIDE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U
CHLOROBENZENE	UG/L	5 U	5 U	5 U	5 U	0 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U
CHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	5 U	10 U	10 U	10 U	10 U
CHLOROFORM	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	20 U	5 U	5 U	5 U	5 U
CHLOROMETHANE(METHYL CHLORIDE)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	5 U	10 U	10 U	10 U	10 U
CIS-1,3-DICHLOROPROPENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIBROMOCHLOROMETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	200 U	5 U	5 U	5 U	5 U
DIBROMOMETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	1.3 J	5 U	5 U	5 U	5 U
DICHLORODIFLUOROMETHANE	UG/L	20 U	20 U	20 UJ	20 U	20 U	20 U		20 U	20 U	5 U	20 UJ	20 UJ	20 UJ	20 U
ETHYLBENZENE	UG/L	5 U	5 U	5 U	1 J	5 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U
IODOMETHANE	UG/L	5 U	5 U	5 UJ	5 U	5 U	5 U		5 U	5 U	5 U	5 U	5 UJ	5 UJ	5 U
ISOBUTYL ALCOHOL (ISOBUTANOL)	UG/L	200 U	200 U	200 U	200 U	200 U	200 U		200 U	200 U	5 U	200 U	200 U	200 U	200 U
METHYLENE CHLORIDE	UG/L	5 U	5 U	5 U	1.7 J	4.3 J	5 U		5 U	1.3 J	5 U	5 U	5 U	5 U	5 U
STYRENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BVR BND	BVR BND	BVR BND	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK
SAMPLE NAME	UNITS	03C03	03C08A	03C09	03B10	03C02P2	03C03P2	03C03P2,D	03C04	03C05	03C06	03C07	03C08AP2	03C09P2	03C10
VOCs(CONT'D..)															
TETRACHLOROETHENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	10 U	5 U	5 U	5 U	5 U
TOLUENE	UG/L	5 U	5 U	5 U	3 J	0 U	5 U		5 U	5 U	10 U	5 U	5 U	5 U	5 U
TRANS-1,3-DICHLOROPROPENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U
TRICHLOROETHENE	UG/L	5 U	5 U	5 U	5 U	0	200		5 U	5 U	0.62	2.6 J	51	84	73
TRICHLOROFLUOROMETHANE	UG/L	5 U	5 U	5 UJ	5 U	5 U	5 U		5 U	5 U	0.05 U	5 U	5 U	5 UJ	5 U
VINYL ACETATE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U
VINYL CHLORIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U	10 U	10 U
XYLENE, TOTAL	UG/L	5 U	5 U	5 U	7.1	5 U	5 U		5 U	5 U	5 U	5 U	5 U	5 U	5 U
WATER QUALITY PARAMETERS															
NITRATE NITROGEN	MG/L	0.5 U	0.5 U	0.5 U	0.5 U		4.4		0.5 U	0.62	0.5 U	0.5 U	3.8	4.3	1.8
SULFIDE, TOTAL	MG/L	0.05 U	0.05 U	0.05 U	0.05 U	0 U	0.05 U		0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	ALLUV
SAMPLE NAME	UNITS	03C11	03C12	03C14	03C17	03C20	03C25	03C26	03C27	03C28	03C30	03C31	03C33	03C37	03B02
EXPLOSIVES															
1,3-DINITROBENZENE	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,3-DINITROBENZENE(2)	UG/L	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
1,3,5-TRINITROBENZENE	UG/L	2 U	2 U	2 U	2 U	6.7	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,3,5-TRINITROBENZENE(2)	UG/L	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
2,4-DINITROTOLUENE	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,4-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-TRINITROTOLUENE (TNT)	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,6-DINITROTOLUENE	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,6-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HMX	UG/L	3.1 V	23 V	2 U	2 U	23 V	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
HMX(2)	UG/L														
NITROBENZENE	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	1.4 J	2 U	2 U	2 U	2 U	2 U	2 U	2 U
NITROBENZENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	2 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
RDX	UG/L	20	29	2 U	2 U	120	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
RDX(2)	UG/L														
TETRYL	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
INORGANICS															
ALUMINUM, DISSOLVED	MG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ALUMINUM, TOTAL	MG/L	0.2 U	2.2	0.2 U	0.21	0.2 U	0.2 U	0.2 U	4.1	1.2	0.67	1.8	4.3	97.4	0.2 U
ANTIMONY, DISSOLVED	MG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ANTIMONY, TOTAL	MG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ARSENIC, DISSOLVED	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.0063
ARSENIC, TOTAL	MG/L	0.005 U	0.0097	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.021	0.009	0.005 U	0.0021 J	0.02	0.044	0.011
BARIUM, DISSOLVED	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.035 J	0.027 J	0.1 U	0.1 U	0.1 U
BARIUM, TOTAL	MG/L	0.1 U	0.13	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.43	0.066 J	0.035 J	0.3	0.79	0.1 U
BERYLLIUM, DISSOLVED	MG/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
BERYLLIUM, TOTAL	MG/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.0096	0.002 U
CADMIUM, DISSOLVED	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
CADMIUM, TOTAL	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.017	0.0099
CHROMIUM, DISSOLVED	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
CHROMIUM, TOTAL	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.041	0.03	0.097	0.42	0.03 U
COBALT, DISSOLVED	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
COBALT, TOTAL	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.072	0.13	0.04 U
COPPER, DISSOLVED	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
COPPER, TOTAL	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.011 J	0.008 J	0.039	0.2	0.03 U
CYANIDE	MG/L	0.01 U	0.011	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
IRON, DISSOLVED	MG/L	0.31	0.07	0.81	0.41	0.093	0.29	0.11	0.04 U	0.078	0.04 U	2.3	1.4	0.15	9.1
IRON, TOTAL	MG/L	0.67	11.2	0.34	0.82	0.072	0.39	0.19	17.9	8.2	1.3	5.3	100	266	11.5
LEAD, DISSOLVED	MG/L	0.02 U	0.005 U	0.01 U	0.02 UJ	0.02 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.05 UJ	0.01 U	0.005 U
LEAD, TOTAL	MG/L	0.01 U	0.022	0.01 U	0.02 UJ	0.005	0.01 U	0.005 U	0.039	0.034	0.0025 J	0.005 U	0.005 UJ	0.12	0.01 U
MANGANESE, DISSOLVED	MG/L	0.043	0.01 U	0.082	0.063	0.01 U	0.023	0.016	0.01 U	0.01 U	0.0021 J	0.089	0.01 U	0.033	0.93
MANGANESE, TOTAL	MG/L	0.048	0.71	0.047	0.08	0.01 U	0.024	0.024	1	0.34	0.05	0.14	7.9	19.2	1
MERCURY, DISSOLVED	MG/L	0.0002 U	0.0002 U	0.0002 U	0.00042	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.00076	0.0002 U	0.0002 U	0.0002 U	0.00039	0.00063

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	ALLUV
SAMPLE NAME	UNITS	03C11	03C12	03C14	03C17	03C20	03C25	03C26	03C27	03C28	03C30	03C31	03C33	03C37	03B02
INORGANICS(CONT'D..)															
MERCURY, TOTAL	MG/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0012	0.0002 U	0.0002 U	0.0002 U	0.0017	0.00051
NICKEL, DISSOLVED	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.017 J	0.04 U	0.04 U	0.04 U
NICKEL, TOTAL	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.035 J	0.033 J	0.13	0.59	0.04 U
SELENIUM, DISSOLVED	MG/L	0.01 U	0.01 U	0.005 U	0.005 U	0.005 U	0.005 U	0.01 U	0.01 U	0.005 U	0.005 U	0.005 U	0.01 UJ	0.01 U	0.005 U
SELENIUM, TOTAL	MG/L	0.01 U	0.01 U	0.005 U	0.01 UJ	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.02 U	0.01 U	0.005 U
SILVER, DISSOLVED	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
SILVER, TOTAL	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
THALLIUM, DISSOLVED	MG/L	0.02 U	0.01 U	0.01 U	0.02 U	0.005 U	0.01 U	0.01 U	0.005 U	0.01 U	0.01 U	0.02 U	0.01 U	0.01 U	0.005 U
THALLIUM, TOTAL	MG/L	0.02 U	0.02 U	0.01 U	0.025 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.02 U	0.025 U	0.02 U	0.01 U	0.005 U
TIN, DISSOLVED	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.026 J	0.1 U	0.1 U	0.1 U
TIN, TOTAL	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
VANADIUM, DISSOLVED	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
VANADIUM, TOTAL	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.006 J	0.04 U	0.04 U	0.25	0.04 U
ZINC, DISSOLVED	MG/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.012	0.01 U	0.012	0.01 U	0.022	0.022
ZINC, TOTAL	MG/L	0.022	0.11	0.074	0.01 U	0.01 U	0.015 B	0.027	0.2	0.089 B	0.022	0.02	0.3	1.2 B	0.022 B
PCBs															
PCB-1016	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1221	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1232	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1242	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1248	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1254	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1260	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PESTICIDES															
1,4-DIOXANE	UG/L	5000 UR	500 U	500 U	500 U	12000 UU	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U
2,4-D	UG/L	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U
2,4,5-T	UG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2,4,5-TP	UG/L	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U
4,4'-DDD	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDT	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
A-ENDOSULFAN	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
ALDRIN	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
ALDRIN(2)	UG/L														
ALPHA-BHC	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
ALPHA-CHLORDANE	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
ARAMITE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
B-ENDOSULFAN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
BETA-BHC	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
DELTA-BHC	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
DIALLATE	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
DIELDRIN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
DIMETHOATE	UG/L	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	ALLUV
SAMPLE NAME	UNITS	03C11	03C12	03C14	03C17	03C20	03C25	03C26	03C27	03C28	03C30	03C31	03C33	03C37	03B02
PESTICIDES(CONT'D..)															
DISULFOTON	UG/L	50 UJ	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	1.2 J
ENDOSULFAN SULFATE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
ENDRIN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.14	0.1 U	0.1 U
ENDRIN ALDEHYDE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
ENDRIN(2)	UG/L												0.1 U		
ETHYL PARATHION	UG/L	50 U	50 U	50 U	50 UJ	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 UJ	50 U	50 U
FAMPHUR	UG/L	0 UJ	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
GAMMA-BHC (LINDANE)	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
GAMMA-CHLORDANE	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
HEPTACHLOR	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
HEPTACHLOR EPOXIDE	UG/L	0.05 U	0.05 U	0.12	0.05 U	0.05 U	0.05 U	0.24	0.05 U	0.05 U	0.05 U	0.95	0.05 U	0.05 U	0.05 U
HEPTACHLOR EPOXIDE(2)	UG/L			0.05 U				0.05 U				0.05 U			
ISODRIN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
KEPONE	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
METHOXYCHLOR	UG/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYL METHANESULFONATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
METHYL PARATHION	UG/L	50 U	50 U	50 U	50 UJ	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 UJ	50 U	50 U
PHORATE	UG/L	100 UJ	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
PRONAMIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
SULFOTEPP	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
THIONAZIN	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
TOXAPHENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SVOCs															
1-NAPHTHYLAMINE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-TRICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4,5-TETRACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-NAPHTHOQUINONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-ACETYLAMINOFLUORENE	UG/L	100 UJ	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
2-CHLORONAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-CHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-METHYL-4,6-DINITROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2-METHYLNAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-METHYLPHENOL (O-CRESOL)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-NAPHTHYLAMINE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-NITROANILINE	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2-NITROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-PICOLINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-SEC-BUTYL-4,6-DINITROPHENOL	UG/L	10 UJ	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
2,3,4,6-TETRACHLOROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2,4-DICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	ALLUV
SAMPLE NAME	UNITS	03C11	03C12	03C14	03C17	03C20	03C25	03C26	03C27	03C28	03C30	03C31	03C33	03C37	03B02
SVOCs (CONT'D..)															
2,4-DIMETHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DINITROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2,4,5-TRICHLOROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2,4,6-TRICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,6-DICHLOROPHENOL	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3-METHYLCHOLANTHRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3-NITROANILINE	UG/L	50 UJ	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
3+4-METHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-DICHLOROBENZIDINE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
3,3-DIMETHYLBENZIDINE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-AMINOBIPHENYL	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-BROMOPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLORO-3-METHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLOROANILINE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLOROPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-NITROANILINE	UG/L	50 UJ	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4-NITROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4-NITROQUINOLINE-1-OXIDE	UG/L	0 UJ	0 U	0 U	0 UJ	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 UJ	0 U	0 U
4-PHENYLENEDIAMINE	UG/L	0 UJ	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
5-NITRO-O-TOLUIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
7,12-DIMETHYLBENZ(A)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ACENAPHTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ACENAPHTHYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ACETOPHENONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ANILINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
A,A-DIMETHYLPHENETHYLAMINE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(A)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(A)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(B)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(G,H,I)PERYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(K)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHOXY)METHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHYL) ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1.8 J	10 U	10 U	10 U	5 J	1.2 J
BUTYLBENZYLPHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROBENZILATE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
CHLOROPRENE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
CHRYSENE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIBENZOFURAN	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIBENZO(A,H)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	ALLUV
SAMPLE NAME	UNITS	03C11	03C12	03C14	03C17	03C20	03C25	03C26	03C27	03C28	03C30	03C31	03C33	03C37	03B02
SVOCs (CONT'D..)															
DIMETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DI-N-BUTYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	2.1 J	10 U
DI-N-OCTYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIPHENYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ETHYL METHACRYLATE	UG/L	200 U	20 U	20 U	20 U	500 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
ETHYL METHANESULFONATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
FLUORENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBUTADIENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROCYCLOPENTADIENE	UG/L	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
HEXACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROPHENE	UG/L	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
HEXACHLOROPROPENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
INDENO(1,2,3-CD)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ISOPHORONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ISOSAFROLE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
METHACRYLONITRILE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
METHAPYRILENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
METHYL METHACRYLATE	UG/L	200 U	20 U	20 U	20 U	500 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
NAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSODIETHYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSODIMETHYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSO-DI-N-BUTYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSO-DI-N-PROPYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSODIPHENYLAMINE	UG/L	1.2 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSOMETHYLETHYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSOMORPHOLINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSOPIPERIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSOPYRROLIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
O-TOLUIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
O,O,O-TRIETHYLPHOSPHOROTHIOATE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
P-DIMETHYLAMINOAZOBENZENE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PENTACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PENTACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PENTACHLORONITROBENZENE	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PENTACHLOROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PHENACETIN	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PHENANTHRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PHENOLS	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PROPIONITRILE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PYRIDINE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	ALLUV
SAMPLE NAME	UNITS	03C11	03C12	03C14	03C17	03C20	03C25	03C26	03C27	03C28	03C30	03C31	03C33	03C37	03B02
SVOCs(CONT'D..)															
SAFROLE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
TRANS-1,4-DICHLORO-2-BUTENE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
VOCs															
1,1-DICHLOROETHANE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-DICHLOROETHENE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,1-TRICHLOROETHANE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,1,2-TETRACHLOROETHANE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2-TRICHLOROETHANE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2,2-TETRACHLOROETHANE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-DIBROMO-3-CHLOROPROPANE	UG/L	100 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DIBROMOETHANE	UG/L	100 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROETHENE(TOTAL)	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROPROPANE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2,3-TRICHLOROPROPANE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-BUTANONE (MEK)	UG/L	100 U	2.3 J	10 U	10 U	250 U	10 U	2.3 J	10 U	10 U	2.4 J	1.7 J	10 U	10 U	10 U
2-HEXANONE	UG/L	100 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-METHYL-2-PENTANONE (MIBK)	UG/L	100 UJ	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ACETONE	UG/L	100 U	10 U	10 U	10 U	250 U	7.6 J	5.2 J	4.9 J	3.5 J	5.6 J	3.6 J	5.4 J	4.5 J	10 U
ACETONITRILE	UG/L	2000 U	200 U	200 U	200 U	5000 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
ACROLEIN	UG/L	1000 UJ	100 U	100 U	100 U	2500 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
ACRYLONITRILE	UG/L	1000 U	100 U	100 U	100 U	2500 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
ALLYL CHLORIDE	UG/L	100 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZENE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BENZYL ALCOHOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	2 J	10 U	10 U	10 U	1.4 J	10 U
BROMODICHLOROMETHANE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BROMOFORM	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BROMOMETHANE (METHYL BROMIDE)	UG/L	100 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
CARBON DISULFIDE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	1.1 J	5 U	5 U	5 U
CARBON TETRACHLORIDE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
CHLOROBENZENE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
CHLOROETHANE	UG/L	100 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROFORM	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
CHLOROMETHANE(METHYL CHLORIDE)	UG/L	100 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
CIS-1,3-DICHLOROPROPENE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIBROMOCHLOROMETHANE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIBROMOMETHANE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DICHLORODIFLUOROMETHANE	UG/L	200 UJ	20 U	20 U	20 UJ	500 U	20 U	20 U	20 U	20 U	20 U	20 U	20 UJ	20 U	20 U
ETHYLBENZENE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1.3 J	5 U
IODOMETHANE	UG/L	50 UJ	5 U	5 U	5 UJ	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U
ISOBUTYL ALCOHOL (ISOBUTANOL)	UG/L	2000 U	200 U	200 U	200 U	5000 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
METHYLENE CHLORIDE	UG/L	18 J	1.6 J	5 U	5 U	120 U	3.2 J	1.4 J	2.4 J	1.5 J	1.1 J	5 U	5 U	1.4 J	1.2 J
STYRENE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

TABLE A-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	ALLUV
SAMPLE NAME	UNITS	03C11	03C12	03C14	03C17	03C20	03C25	03C26	03C27	03C28	03C30	03C31	03C33	03C37	03B02
VOCs(CONT'D..)															
TETRACHLOROETHENE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TOLUENE	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2.7 J	5 U
TRANS-1,3-DICHLOROPROPENE	UG/L	50 U	5 U	5 U	5 UJ	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U	5 U
TRICHLOROETHENE	UG/L	1400	20	5 U	5 U	4300	5 U	3.4 J	2.5 J	5 U	5 U	5 U	5 U	5 U	5 U
TRICHLOROFLUOROMETHANE	UG/L	50 UJ	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
VINYL ACETATE	UG/L	100 UJ	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
VINYL CHLORIDE	UG/L	100 U	10 U	10 U	10 U	250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
XYLENE, TOTAL	UG/L	50 U	5 U	5 U	5 U	120 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10	2.9 J
WATER QUALITY PARAMETERS															
NITRATE NITROGEN	MG/L	1.6	1.5	0.5 U	0.18 J	2	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.26 J	0.5 U	0.5 U
SULFIDE, TOTAL	MG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U

TABLE A-2.d.2
ORR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C11	06C12	06C13	06C14	06C15	06C16	06C18	06C11P2	06C13P2	06C14P2	06C18P2
EXPLOSIVES												
1,3-DINITROBENZENE	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,3-DINITROBENZENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3,5-TRINITROBENZENE	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
1,3,5-TRINITROBENZENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UR	10 U	10 U
2,4-DINITROTOLUENE	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,4-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-TRINITROTOLUENE (TNT)	UG/L	2 U	2 U	4.1	2 U	4.9	2 U	2 U	2 U	2 U	2 U	2 U
2,4,6-TRINITROTOLUENE (TNT)(2)	UG/L			4.3		5.1						
2,6-DINITROTOLUENE	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
2,6-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HMX	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
NITROBENZENE	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
NITROBENZENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
RDX	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
TETRYL	UG/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
INORGANICS												
ALUMINUM, DISSOLVED	MG/L	1.5	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ALUMINUM, TOTAL	MG/L	0.2 U	0.2 U	0.2 U	0.78	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.46	0.2 U
ANTIMONY, DISSOLVED	MG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ANTIMONY, TOTAL	MG/L	0.2 U		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ARSENIC, DISSOLVED	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.025	0.005 U	0.015
ARSENIC, TOTAL	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.028	0.005 U	0.015
BARIUM, DISSOLVED	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.12	0.1	0.1 U	0.1 U	0.1 U	0.14
BARIUM, TOTAL	MG/L	0.1 U		0.1 U	0.1 U	0.1 U	0.12	0.1	0.1 U	0.1 U	0.1 U	0.13
BERYLLIUM, DISSOLVED	MG/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
BERYLLIUM, TOTAL	MG/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
CADMIUM, DISSOLVED	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
CADMIUM, TOTAL	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
CHROMIUM, DISSOLVED	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
CHROMIUM, TOTAL	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
COBALT, DISSOLVED	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
COBALT, TOTAL	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
COPPER, DISSOLVED	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
COPPER, TOTAL	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
CYANIDE	MG/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
IRON, DISSOLVED	MG/L	0.72	0.69	0.061	0.18	0.04 U	0.04 U	3.7	0.34	11.9	0.04 U	55.9
IRON, TOTAL	MG/L	0.3	0.7	1.1	9	0.22	0.045	3.5	0.4	7.3	1.2	55.6
LEAD, DISSOLVED	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.01 U
LEAD, TOTAL	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.012	0.01 U

TABLE A-2.d.2
ORR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C11	06C12	06C13	06C14	06C15	06C16	06C18	06C11P2	06C13P2	06C14P2	06C18P2
INORGANICS(CONT'D..)												
MANGANESE, DISSOLVED	MG/L	0.076	0.31	0.015	0.092	0.01 U	0.01 U	0.13	0.057	0.36	0.013	0.62
MANGANESE, TOTAL	MG/L	0.072	0.31	0.035	0.81	0.036	0.01 U	0.13	0.06	0.39	0.024	0.61
MERCURY, DISSOLVED	MG/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.00031	0.0002 U	0.0002 U	0.0002 U
MERCURY, TOTAL	MG/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.00062	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
NICKEL, DISSOLVED	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
NICKEL, TOTAL	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
SELENIUM, DISSOLVED	MG/L	0.005 U	0.005 U	0.01 U	0.01 U	0.01 U	0.005 U	0.005 U	0.005 U	0.005 U	0.01 U	0.005 U
SELENIUM, TOTAL	MG/L	0.005 U	0.005 U	0.005 U	0.01 U	0.005 U	0.005 U	0.005 U	0.005 U	0.01 UJ	0.01 U	0.005 U
SILVER, DISSOLVED	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
SILVER, TOTAL	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
THALLIUM, DISSOLVED	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.01 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
THALLIUM, TOTAL	MG/L	0.01 U	0.005 U	0.005 U	0.005 U	0.005 U	0.025 U	0.005 U	0.005 U	0.01 UJ	0.005 U	0.005 U
TIN, DISSOLVED	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
TIN, TOTAL	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	1.1	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
VANADIUM, DISSOLVED	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
VANADIUM, TOTAL	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
ZINC, DISSOLVED	MG/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.019	0.01 U
ZINC, TOTAL	MG/L	0.019	0.068	0.04	0.04	0.01 U	0.01 U	0.044	0.01 U	0.01 U	0.02	0.14
PCBs												
PCB-1016	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1221	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1232	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1242	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1248	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1254	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1260	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PESTICIDES												
1,4-DIOXANE	UG/L	500 UR	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 UR	500 U	500 U
2,4-D	UG/L	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U
2,4,5-T	UG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2,4,5-TP	UG/L	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U
4,4'-DDD	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDT	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
A-ENDOSULFAN	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
ALDRIN	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
ALDRIN(2)	UG/L					5.1						
ALPHA-BHC	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
ALPHA-CHLORDANE	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U

TABLE A-2.d.2
ORR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C11	06C12	06C13	06C14	06C15	06C16	06C18	06C11P2	06C13P2	06C14P2	06C18P2
PESTICIDES(CONT'D..)												
ARAMITE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
B-ENDOSULFAN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
BETA-BHC	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
DELTA-BHC	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
DIALLATE	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
DIELDRIN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
DIMETHOATE	UG/L	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
DISULFOTON	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
ENDOSULFAN SULFATE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
ENDRIN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
ENDRIN ALDEHYDE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
ENDRIN(2)	UG/L											
ETHYL PARATHION	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
FAMPHUR	UG/L	0 UJ	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
GAMMA-BHC (LINDANE)	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
GAMMA-CHLORDANE	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
HEPTACHLOR	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
HEPTACHLOR EPOXIDE	UG/L	0.05 U	0.05 U	0.62	0.05 U	2	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
HEPTACHLOR EPOXIDE(2)	UG/L			0.05 U		0.05 U						
ISODRIN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
KEPONE	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
METHOXYCHLOR	UG/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYL METHANESULFONATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
METHYL PARATHION	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PHORATE	UG/L	100 UJ	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 UJ	100 U	100 U
PRONAMIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
SULFOTEPP	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
THIONAZIN	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
TOXAPHENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SVOCs												
1-NAPHTHYLAMINE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-TRICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4,5-TETRACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-NAPHTHOQUINONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-ACETYLAMINOFLUORENE	UG/L	100 UJ	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 UJ	100 U	100 U
2-CHLORONAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

TABLE A-2.d.2
ORR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C11	06C12	06C13	06C14	06C15	06C16	06C18	06C11P2	06C13P2	06C14P2	06C18P2
SVOCs(CONT'D..)												
2-CHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-METHYL-4,6-DINITROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2-METHYLNAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-METHYLPHENOL (O-CRESOL)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-NAPHTHYLAMINE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
2-NITROANILINE	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2-NITROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-PICOLINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-SEC-BUTYL-4,6-DINITROPHENOL	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
2,3,4,6-TETRACHLOROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2,4-DICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DIMETHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DINITROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2,4,5-TRICHLOROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2,4,6-TRICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,6-DICHLOROPHENOL	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
3-METHYLCHOLANTHRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3-NITROANILINE	UG/L	50 UJ	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
3+4-METHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-DICHLOROBENZIDINE	UG/L	20 U	1.3 J	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
3,3-DIMETHYLBENZIDINE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-AMINOBIPHENYL	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
4-BROMOPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLORO-3-METHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLOROANILINE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLOROPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-NITROANILINE	UG/L	50 UJ	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4-NITROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4-NITROQUINOLINE-1-OXIDE	UG/L	0 UJ	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 UJ	0 U	0 U
4-PHENYLENEDIAMINE	UG/L	0 UJ	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 UJ	0 U	0 U
5-NITRO-O-TOLUIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
7,12-DIMETHYLBENZ(A)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ACENAPHTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ACENAPHTHYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ACETOPHENONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ANILINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
A,A-DIMETHYLPHENETHYLAMINE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(A)ANTHRACENE	UG/L	1.8 J	10 U	10 U	10 U	10 U	10 U	10 U	1.2 J	10 U	10 U	10 U

TABLE A-2.d.2
ORR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C11	06C12	06C13	06C14	06C15	06C16	06C18	06C11P2	06C13P2	06C14P2	06C18P2
SVOCs(CONT'D..)												
BENZO(A)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(B)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(G,H,I)PERYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(K)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHOXY)METHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHYL) ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	4.6 J	10 U	10 U	10 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	10 U	1.3 J	10 U	10 U	10 U	10 U	2.1 J	1.1 J	10 U	10 U	3.7 J
BUTYLBENZYLPHTHALATE	UG/L	1.5 J	3.5 J	10 U	10 U	10 U	10 U	3.6 J	0.1 U	10 U	10 U	2.8 J
CHLOROBENZILATE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	5 U	0.1 U	0.1 U	0.1 U
CHLOROPRENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1.4 J	5 U	5 U	5 U
CHRYSENE	UG/L	1.6 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIBENZOFURAN	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIBENZO(A,H)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIMETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DI-N-BUTYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DI-N-OCTYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	2.1 J
DIPHENYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U
ETHYL METHACRYLATE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U	20 U	10 U	20 U	20 U	20 U
ETHYL METHANESULFONATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
FLUORENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBUTADIENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROCYCLOPENTADIENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0 U	10 U	10 U	10 U
HEXACHLOROPHENE	UG/L	0 U	0 U	0 U	0 U	0 U	0 U	0 U	10 U	0 U	0 U	0 U
HEXACHLOROPROPENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
INDENO(1,2,3-CD)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ISOPHORONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U
ISOSAFROLE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U	20 U	5 U	20 U	20 U	20 U
METHACRYLONITRILE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U
METHAPYRILENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U
METHYL METHACRYLATE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U	20 U	10 U	20 U	20 U	20 U
NAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSODIETHYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSODIMETHYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSO-DI-N-BUTYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

TABLE A-2.d.2
ORR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C11	06C12	06C13	06C14	06C15	06C16	06C18	06C11P2	06C13P2	06C14P2	06C18P2
SVOCs(CONT'D..)												
N-NITROSO-DI-N-PROPYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSODIPHENYLAMINE	UG/L	1.6 J	2.2 J	10 U	10 U	10 U	10 U	1.6 J	10 U	10 U	10 U	1.6 J
N-NITROSOMETHYLETHYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSOMORPHOLINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSOPIPERIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSOPYRROLIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
O-TOLUIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
O,O,O-TRIETHYLPHOSPHOROTHIOATE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
P-DIMETHYLAMINOAZOBENZENE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
PENTACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PENTACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	10 U	10 U	10 U
PENTACHLORONITROBENZENE	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PENTACHLOROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U	50 U	50 U	50 U
PHENACETIN	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PHENANTHRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PHENOLS	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 U	10 U	10 U	10 U
PROPIONITRILE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U
PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U	10 U
PYRIDINE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U	20 U	10 U	20 U	20 U	20 U
SAFROLE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	5 U	10 UJ	10 U	10 U
TRANS-1,4-DICHLORO-2-BUTENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
VOCs												
1,1-DICHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-DICHLOROETHENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,1-TRICHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,1,2-TETRACHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2-TRICHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2,2-TETRACHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U
1,2-DIBROMO-3-CHLOROPROPANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DIBROMOETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROETHENE(TOTAL)	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROPROPANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2,3-TRICHLOROPROPANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U
2-BUTANONE (MEK)	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-HEXANONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
4-METHYL-2-PENTANONE (MIBK)	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
ACETONE	UG/L	10 U	18	10 U	12	10 U	10 U	16	200 U	10 UJ	10 U	10 U
ACETONITRILE	UG/L	200 U	200 U	200 U	200 U	200 U	200 U	200 U	100 U	200 U	200 U	200 U

TABLE A-2.d.2
ORR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C11	06C12	06C13	06C14	06C15	06C16	06C18	06C11P2	06C13P2	06C14P2	06C18P2
VOCs(CONT'D..)												
ACROLEIN	UG/L	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 UJ	100 U	100 U
ACRYLONITRILE	UG/L	100 U	100 U	100 U	100 U	100 U	100 U	100 U	10 U	100 U	100 U	100 U
ALLYL CHLORIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 U	10 U	10 U	10 U
BENZENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U
BENZYL ALCOHOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BROMOFORM	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U
BROMOMETHANE (METHYL BROMIDE)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 U	10 UJ	10 U	10 U
CARBON DISULFIDE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
CARBON TETRACHLORIDE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
CHLOROBENZENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U
CHLOROETHANE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	5 U	10 U	10 U	10 U
CHLOROFORM	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U
CHLOROMETHANE(METHYL CHLORIDE)	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	5 U	10 U	10 U	10 U
CIS-1,3-DICHLOROPROPENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIBROMOCHLOROMETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIBROMOMETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	20 U	5 U	5 U	5 U
DICHLORODIFLUOROMETHANE	UG/L	20 UJ	20 U	20 U	20 U	20 U	20 U	20 U	5 U	20 UJ	20 U	20 U
ETHYLBENZENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IODOMETHANE	UG/L	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	200 U	5 UJ	5 U	5 U
ISOBUTYL ALCOHOL (ISOBUTANOL)	UG/L	200 U	200 U	200 U	200 U	200 U	200 U	200 U	5 U	200 U	200 U	200 U
METHYLENE CHLORIDE	UG/L	5 U	2.2 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
STYRENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TETRACHLOROETHENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TOLUENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TRANS-1,3-DICHLOROPROPENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TRICHLOROETHENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	1.8 J	5 U	5 U	5 U
TRICHLOROFLUOROMETHANE	UG/L	5 UJ	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U	5	5 U
VINYL ACETATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
VINYL CHLORIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 U	10 U	10 U	10 U
XYLENE, TOTAL	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.05 U	5 U	5 U	5 U
WATER QUALITY PARAMETER												
SULFIDE, TOTAL	MG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	10 U	0.05 U	0.05 U	0.05 U

TABLE A-3.d.1
DR GROUND WATER SAMPLE RESULTS
1990 - 1992 WES LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK
SAMPLE NAME		06C01	06C01	06C01	06C02	06C02	06C02	06C03	06C03	06C03	06C04	06C04	06C04	06C05
	UNITS\DATE	90-11	91-06	91-11	91-03	91-06	91-11	91-03	91-06	91-11	91-03	91-06	91-11	91-03
EXPLOSIVES														
1,3,5-TRINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,6-DINITROTOLUENE	MG/L	<0.0097 U	<0.010 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.010 U
DINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
HMX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
RDX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
TETRYL	MG/L	<0.020 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF
SAMPLE NAME		06C05	06C05	06C06	06C06	06C06	06C07	06C07	06C07	06C08	06C08	06C08	06-01A	06-01A
	UNITS\DATE	91-06	91-11	91-03	91-06	91-11	91-03	91-06	91-11	90-11	91-06	91-11	90-11	91-06
EXPLOSIVES														
1,3,5-TRINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.20 U	<0.020 U	<0.020 U	<0.20 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,6-DINITROTOLUENE	MG/L	<0.010 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.0097 U	<0.010 U	<0.020 U	<0.027 U	<0.010 U
DINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
HMX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
RDX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
TETRYL	MG/L	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.020 U	<0.050 U

AQUIFER		SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF
SAMPLE NAME		06-06	06-06	06-06	06-07	06-07	06-07	06-12	06-12	06-12	06C01P3	06C01P3	06C01P3	06C02P2
	UNITS\DATE	90-11	91-06	91-11	90-11	91-06	91-11	90-11	91-06	91-11	90-11	91-06	91-11	91-03
EXPLOSIVES														
1,3,5-TRINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,6-DINITROTOLUENE	MG/L	<0.0097 U	<0.010 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.0096 U	<0.010 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.010 U
DINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
HMX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
RDX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
TETRYL	MG/L	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.020 U	<0.050 U	<0.050 U	<0.020 U	<0.050 U	<0.050 U	<0.050 U

TABLE A-3.d.1
DR GROUND WATER SAMPLE RESULTS
1990 - 1992 WES LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF	SURF
SAMPLE NAME		06C02P2	06C02P2	06C03P2	06C03P2	06C03P2	06C04P2	06C04P2	06C04P2	06C06P2	06C06P2	06C06P2	06C08P2	06C08P2
	UNITS\DATE	91-06	91-11	91-03	91-06	91-11	91-03	91-06	91-11	91-03	91-06	91-11	90-11	91-06
EXPLOSIVES														
1,3,5-TRINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
2,6-DINITROTOLUENE	MG/L	<0.010 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.010 U	<0.010 U	<0.020 U	<0.011 U	<0.010 U
DINITROBENZENE	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
HMX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
RDX	MG/L	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U	<0.020 U
TETRYL	MG/L	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U	<0.050 U

AQUIFER		SURF
SAMPLE NAME		06C08P2
	UNITS\DATE	91-11
EXPLOSIVES		
1,3,5-TRINITROBENZENE	MG/L	<0.020 U
2,4-DINITROTOLUENE	MG/L	<0.020 U
2,4,6-TRINITROTOLUENE (TNT)	MG/L	<0.020 U
2,6-DINITROTOLUENE	MG/L	<0.020 U
DINITROBENZENE	MG/L	<0.020 U
HMX	MG/L	<0.020 U
RDX	MG/L	<0.020 U
TETRYL	MG/L	<0.050 U

TABLE A-3.d.2
DR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C02	06C03	06C04	06C05	06C06	06C07	06C08	06C03P2	06C04P2	06C06P2	06C08P2
EXPLOSIVES												
1,3-DINITROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 UJ	10 UJ	2 U	10 U	10 U	10 U	2 U
1,3-DINITROBENZENE(2)	UG/L							10 UJ				10 UJ
1,3,5-TRINITROBENZENE	UG/L	10 U	10 UR	10 U	10 U	10 UR	10 UR	2 U	10 UR	10 UR	10 U	2 U
1,3,5-TRINITROBENZENE(2)	UG/L							10 UR				10 UR
2,4-DINITROTOLUENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	2 U	10 U	10 U	10 U	2 U
2,4-DINITROTOLUENE(2)	UG/L							10 U				10 U
2,4,6-TRINITROTOLUENE (TNT)	UG/L							2 U				2 U
2,6-DINITROTOLUENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	2 U	10 U	10 U	10 U	2 U
2,6-DINITROTOLUENE(2)	UG/L							10 U				10 U
HMX	UG/L							2 U				2 U
NITROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	2 U	10 U	10 U	10 U	2 U
NITROBENZENE(2)	UG/L							10 U				10 U
RDX	UG/L							2 U				2 U
TETRYL	UG/L							2 U				2 U
INORGANICS												
ALUMINUM, DISSOLVED	MG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	7.2	0.2 U	0.2 U	0.2 U	0.32
ALUMINUM, TOTAL	MG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	1.5	12.7	1.4	0.2 U	0.37
ANTIMONY, DISSOLVED	MG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ANTIMONY, TOTAL	MG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ARSENIC, DISSOLVED	MG/L	0.005 U	0.012	0.005 U	0.005 U	0.01 U	0.005 U	0.01 U	0.005 U	0.005 U	0.005 U	0.005 U
ARSENIC, TOTAL	MG/L	0.005 U	0.012	0.01 U	0.005 U	0.005 UJ	0.005 U	0.005 UJ	0.0057	0.005 U	0.005 U	0.005 U
BARIUM, DISSOLVED	MG/L	0.11	0.1 U	0.1 U	0.1 U	0.1 U	0.25	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
BARIUM, TOTAL	MG/L	0.1	0.1 U	0.14	0.1 U	0.1 U	0.24	0.1 U	0.13	0.1 U	0.1 U	0.1 U
BERYLLIUM, DISSOLVED	MG/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
BERYLLIUM, TOTAL	MG/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
CADMIUM, DISSOLVED	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
CADMIUM, TOTAL	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
CHROMIUM, DISSOLVED	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
CHROMIUM, TOTAL	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03	0.03 U	0.03 U	0.03 U
COBALT, DISSOLVED	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
COBALT, TOTAL	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
COPPER, DISSOLVED	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
COPPER, TOTAL	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
CYANIDE	MG/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
IRON, DISSOLVED	MG/L	2.1	7.7	1.7	0.04 U	0.19	0.04 U	2.3	0.04 U	0.061	0.04 U	16.4
IRON, TOTAL	MG/L	2.2	12	1.6	0.04 U	0.26	0.06	1.9	16	4.9	0.091	16.9
LEAD, DISSOLVED	MG/L	0.01 U	0.005 U	0.01 U	0.01 U	0.005 U	0.005 U	0.005 U	0.01 U	0.02 UJ	0.005 U	0.005 U
LEAD, TOTAL	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 UJ	0.0061	0.015 J	0.005 UJ	0.005 U	0.01 UJ
MANGANESE, DISSOLVED	MG/L	0.14	0.41	0.14	0.01 U	0.084	0.01 U	0.016	0.01 U	0.023	0.01 U	0.63

TABLE A-3.d.2
DR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C02	06C03	06C04	06C05	06C06	06C07	06C08	06C03P2	06C04P2	06C06P2	06C08P2
INORGANICS(CONT'D..)												
MANGANESE, TOTAL	MG/L	0.14	0.35	0.13	0.01 U	0.087	0.01 U	0.051	0.19	0.69	0.01 U	0.63
MERCURY, DISSOLVED	MG/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
MERCURY, TOTAL	MG/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
NICKEL, DISSOLVED	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
NICKEL, TOTAL	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.05	0.04 U	0.04 U	0.04 U
SELENIUM, DISSOLVED	MG/L	0.01 U	0.01 UJ	0.005 U	0.005 U	0.005 U	0.01 UJ	0.005 U	0.005 U	0.0081	0.01 U	0.01 UJ
SELENIUM, TOTAL	MG/L	0.01 U	0.01 UJ	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.01 UJ	0.005 U	0.005 U	0.005 U
SILVER, DISSOLVED	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
SILVER, TOTAL	MG/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U
THALLIUM, DISSOLVED	MG/L	0.01 U	0.005 U	0.01 U	0.01 U	0.01 UJ	0.01 UJ	0.02 UJ	0.005 U	0.01 U	0.01 U	0.005 U
THALLIUM, TOTAL	MG/L	0.01 U	0.01 UJ	0.02 U	0.025 U	0.02 UJ	0.025 UJ	0.025 UJ	0.01 UJ	0.02 UJ	0.005 U	0.005 U
TIN, DISSOLVED	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
TIN, TOTAL	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
VANADIUM, DISSOLVED	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
VANADIUM, TOTAL	MG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
ZINC, DISSOLVED	MG/L	0.015	0.01 U	0.01 U	0.01 U	0.013	0.01 U	0.026	0.01 U	0.01 U	0.018	0.094
ZINC, TOTAL	MG/L	0.012	0.014	0.028	0.01 U	0.014	0.01 U	0.083	0.052	0.043	0.016	0.052
PCBs												
PCB-1016	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1221	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1232	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1242	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1248	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1254	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PCB-1260	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
PESTICIDES												
1,4-DIOXANE	UG/L	500 U	500 UR	500 U	500 U	500 UR	500 UR	500 UR	500 UR	500 UR	500 U	500 UR
2,4-D	UG/L	1.2 U	1.2 U	1.8 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U
2,4,5-T	UG/L	0.2 U	0.2 U	0.3 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2,4,5-TP	UG/L	0.17 U	0.17 U	0.26 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U	0.17 U
4,4'-DDD	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
4,4'-DDT	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
A-ENDOSULFAN	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
ALDRIN	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
ALPHA-BHC	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
ALPHA-CHLORDANE	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
ARAMITE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
B-ENDOSULFAN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U

TABLE A-3.d.2
DR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C02	06C03	06C04	06C05	06C06	06C07	06C08	06C03P2	06C04P2	06C06P2	06C08P2
PESTICIDES(CONT'D..)												
BETA-BHC	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
DELTA-BHC	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
DIALLATE	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
DIELDRIN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
DIMETHOATE	UG/L	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
DISULFOTON	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
ENDOSULFAN SULFATE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
ENDRIN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
ENDRIN ALDEHYDE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
ETHYL PARATHION	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
FAMPHUR	UG/L	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
GAMMA-BHC (LINDANE)	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
GAMMA-CHLORDANE	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
HEPTACHLOR	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
HEPTACHLOR EPOXIDE	UG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
ISODRIN	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
KEPONE	UG/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
METHOXYCHLOR	UG/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYL METHANESULFONATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
METHYL PARATHION	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PHORATE	UG/L	100 U	100 UJ	100 U	100 U	100 UJ	100 UJ	100 UJ	100 UJ	100 UJ	100 U	100 UJ
PRONAMIDE	UG/L	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U
SULFOTEPP	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
THIONAZIN	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
TOXAPHENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
SVOCs												
1-NAPHTHYLAMINE	UG/L	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 UJ
1,2-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-TRICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4,5-TETRACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-NAPHTHOQUINONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-ACETYLAMINOFLUORENE	UG/L	100 U	100 UJ	100 U	100 U	100 UJ	100 UJ	100 UJ	100 UJ	100 UJ	100 U	100 UJ
2-CHLORONAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-CHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-METHYL-4,6-DINITROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2-METHYLNAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-METHYLPHENOL (O-CRESOL)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

TABLE A-3.d.2
DR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C02	06C03	06C04	06C05	06C06	06C07	06C08	06C03P2	06C04P2	06C06P2	06C08P2
SVOCs(CONT'D..)												
2-NAPHTHYLAMINE	UG/L	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U
2-NITROANILINE	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2-NITROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-PICOLINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-SEC-BUTYL-4,6-DINITROPHENOL	UG/L	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 UJ
2,3,4,6-TETRACHLOROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2,4-DICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DIMETHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DINITROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2,4,5-TRICHLOROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
2,4,6-TRICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,6-DICHLOROPHENOL	UG/L	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U
3-METHYLCHOLANTHRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3-NITROANILINE	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
3+4-METHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-DICHLOROBENZIDINE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
3,3-DIMETHYLBENZIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-AMINOBIPHENYL	UG/L	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 UJ
4-BROMOPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLORO-3-METHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLOROANILINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLOROPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-NITROANILINE	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4-NITROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
4-NITROQUINOLINE-1-OXIDE	UG/L	0 U	0 UJ	0 U	0 U	0 UJ	0 UJ	0 UJ	0 UJ	0 UJ	0 U	0 UJ
4-PHENYLENEDIAMINE	UG/L	0 U	0 UJ	0 U	0 U	0 U	0 U	0 U	0 UJ	0 UJ	0 U	0 U
5-NITRO-O-TOLUIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
7,12-DIMETHYLBENZ(A)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ACENAPHTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ACENAPHTHYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ACETOPHENONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ANILINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
A,A-DIMETHYLPHENETHYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(A)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(A)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(B)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(G,H,I)PERYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(K)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

TABLE A-3.d.2
DR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C02	06C03	06C04	06C05	06C06	06C07	06C08	06C03P2	06C04P2	06C06P2	06C08P2
SVOCs(CONT'D..)												
BIS(2-CHLOROETHOXY)METHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHYL) ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10	10 U	10 U
BUTYLBENZYLPHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROBENZILATE	UG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
CHLOROPRENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
CHRYSENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIBENZOFURAN	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIBENZO(A,H)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DIMETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DI-N-BUTYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
DI-N-OCTYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U	10 U	10 UJ
DIPHENYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ETHYL METHACRYLATE	UG/L	20 U	20 U	20 U	20 U	20 UJ	20 UJ	20 UJ	20 U	20 U	20 U	20 UJ
ETHYL METHANESULFONATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
FLUORENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBUTADIENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROCYCLOPENTADIENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROPHENE	UG/L	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U	0 U
HEXACHLOROPROPENE	UG/L	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U
INDENO(1,2,3-CD)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ISOPHORONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
ISOSAFROLE	UG/L	20 U	20 U	20 U	20 U	20 UR	20 UR	20 UR	20 U	20 U	20 U	20 UR
METHACRYLONITRILE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
METHAPYRILENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
METHYL METHACRYLATE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
NAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSODIETHYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSODIMETHYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSO-DI-N-BUTYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSO-DI-N-PROPYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSODIPHENYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSOMETHYLETHYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSOMORPHOLINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

TABLE A-3.d.2
DR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C02	06C03	06C04	06C05	06C06	06C07	06C08	06C03P2	06C04P2	06C06P2	06C08P2
SVOCs(CONT'D..)												
N-NITROSOPIPERIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSOPYRROLIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
O-TOLUIDINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
O,O,O-TRIETHYLPHOSPHOROTHIOATE	UG/L	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U
P-DIMETHYLAMINOAZOBENZENE	UG/L	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 UJ
PENTACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PENTACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PENTACHLORONITROBENZENE	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PENTACHLOROPHENOL	UG/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
PHENACETIN	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PHENANTHRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PHENOLS	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PROPIONITRILE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
PYRIDINE	UG/L	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
SAFROLE	UG/L	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 UJ
TRANS-1,4-DICHLORO-2-BUTENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
VOCs												
1,1-DICHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1-DICHLOROETHENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,1-TRICHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,1,2-TETRACHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2-TRICHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,1,2,2-TETRACHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-DIBROMO-3-CHLOROPROPANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DIBROMOETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROETHENE(TOTAL)	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2-DICHLOROPROPANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
1,2,3-TRICHLOROPROPANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
2-BUTANONE (MEK)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-HEXANONE	UG/L	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 UJ
4-METHYL-2-PENTANONE (MIBK)	UG/L	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 UJ
ACETONE	UG/L	10 U	10 UJ	10 U	12	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 UJ
ACETONITRILE	UG/L	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
ACROLEIN	UG/L	100 U	100 UJ	100 U	100 U	100 UJ	100 UJ	100 UJ	100 UJ	100 UJ	100 U	100 UJ
ACRYLONITRILE	UG/L	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
ALLYL CHLORIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BENZENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

TABLE A-3.d.2
DR GROUND WATER SAMPLE RESULTS
1993 ENSECO LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER		BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF
SAMPLE NAME	UNITS	06C02	06C03	06C04	06C05	06C06	06C07	06C08	06C03P2	06C04P2	06C06P2	06C08P2
VOCs(CONT'D..)												
BENZYL ALCOHOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BROMOFORM	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
BROMOMETHANE (METHYL BROMIDE)	UG/L	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U
CARBON DISULFIDE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
CARBON TETRACHLORIDE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
CHLOROBENZENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
CHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROFORM	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
CHLOROMETHANE(METHYL CHLORIDE)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
CIS-1,3-DICHLOROPROPENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIBROMOCHLOROMETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DIBROMOMETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
DICHLORODIFLUOROMETHANE	UG/L	20 U	20 UJ	20 U	20 U	20 UJ	20 UJ	20 UJ	20 UJ	20 UJ	20 U	20 UJ
ETHYLBENZENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
IODOMETHANE	UG/L	5 U	5 UJ	5 U	5 U	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 U	5 UJ
ISOBUTYL ALCOHOL (ISOBUTANOL)	UG/L	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
METHYLENE CHLORIDE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
STYRENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TETRACHLOROETHENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TOLUENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TRANS-1,3-DICHLOROPROPENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TRICHLOROETHENE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
TRICHLOROFLUOROMETHANE	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
VINYL ACETATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
VINYL CHLORIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
XYLENE, TOTAL	UG/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
WATER QUALITY PARAMETER												
SULFIDE, TOTAL	MG/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.072

APPENDIX 2-3

SUPPLEMENTAL ENVIRONMENTAL MEDIA DATA

OBTAINED IN 1995-1996 FOR ABG, ORR, AND DR

APPENDIX B

HNUS 1995-1996 DATABASE

TABLE [illegible]a.1
ABG SURFACE SOIL SAMPLES - DIOXINE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03SS-A06	03SS-A06,D	03SS-A07	03SS-A08
ANALYTES	UNITS	Surface	Surface	Surface	Surface
DIOXINES					
1,2,3,4,5,6,7,8-OCTACHLORODIBENZOFURAN	PPT	25.4 BJ	10.3 BJ	31.1 BJ	13.4 BJ
1,2,3,4,5,6,7,8-OCTACHLORODIBENZO-P-DIOXIN	PPT	1170 BJ	1510 BJ	824 BJ	256 BJ
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	PPT	8.96 BJ	4.41 BU	11.4 BJ	7.09 BJ
1,2,3,4,6,7,8-HEPTACHLORODIBENZO-P-DIOXIN	PPT	33.6 BJ	42.3 BJ	30 BJ	38.7 BJ
1,2,3,4,7,8-HEXACHLORODIBENZOFURAN	PPT	1.10 U	0.16 U	2.45	1.03 U
1,2,3,4,7,8-HEXACHLORODIBENZO-P-DIOXIN	PPT	0.17 U	0.84	0.18 U	0.20 U
1,2,3,4,7,8,9-HEPTACHLORODIBENZOFURAN	PPT	0.21 U	0.79 U	0.58 U	2.23 U
1,2,3,6,7,8-HEXACHLORODIBENZOFURAN	PPT	0.61 U	0.14 U	1.62 U	0.86 U
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	PPT	1.11	0.84 U	1.04 U	2.39
1,2,3,7,8-PENTACHLORODIBENZOFURAN	PPT	0.20 U	0.26 U	0.16 U	0.23 U
1,2,3,7,8-PENTACHLORODIBENZO-P-DIOXIN	PPT	0.22 U	0.21 U	0.17 U	0.49 U
1,2,3,7,8,9-HEXACHLORODIBENZOFURAN	PPT	0.24 U	0.48 BU	0.32 U	1.08 U
1,2,3,7,8,9-HEXACHLORODIBENZO-P-DIOXIN	PPT	1.86	2.39	1.90	3.69
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	PPT	0.23 U	0.16 U	0.31 U	1.04 U
2,3,4,7,8-PENTACHLORODIBENXOFURAN	PPT	0.19 U	0.25 U	0.16 U	0.23 U
2,3,7,8-TETRACHLORODIBENZOFURAN	PPT	0.14 U	0.13 U	1.81 J	2.23
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN	PPT	0.15 U	0.11 U	0.16 U	0.22 U

TABLE B-1.a.2
ABG/JEEP TRAIL SURFACE SOIL SAMPLES
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME ANALYTES	UNITS	03SS-A01 Surface	03SS-A01,DUP Surface	03SS-A02 Surface	03SS-A03 Surface	03SS-A04 Surface	03SS-A05 Surface
EXPLOSIVES							
1,3,5-TRINITROBENZENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U
1,3-DINITROBENZENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U
2,4,6-TRINITROTOLUENE (TNT)	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U
2,4-DINITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U
2,4-DINITROTOLUENE(2)	UG/KG	130 J	76000	99 J	420 U	580	380 U
2,6-DINITROTOLUENE	UG/KG	260 U	260 U	260 U	260 U	260 U	260 U
2,6-DINITROTOLUENE(2)	UG/KG	460 U	4000 J	400 U	420 U	39 J	380 U
HMX	UG/KG	2310	1110 J	2200 U	967 J	449 J	2200 U
M-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U
NITROBENZENE	UG/KG	260 U	260 U	260 U	260 U	260 U	260 U
NITROBENZENE(2)	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
O-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U
P-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U
RDX	UG/KG	2070 J	772 J	1000 U	1000 U	1000 U	1000 U
TETRYL	UG/KG	650 U	650 U	650 U	650 U	650 U	650 U
INORGANICS							
ALUMINUM, TOTAL	MG/KG	6010 J	6480 J	3810 J	5340 J	7550 J	9050 J
ANTIMONY, TOTAL	MG/KG	0.77 UJ	0.82 UJ	0.75 UJ	1.30 J	0.71 UJ	0.93 J
ARSENIC, TOTAL	MG/KG	7.80	8.70	6.50	6.00	8.60	14.3
BARIUM, TOTAL	MG/KG	163	164	121	167	340	2720
BERYLLIUM, TOTAL	MG/KG	0.71	0.74	0.72	0.59	0.55	0.90
CADMIUM, TOTAL	MG/KG	1.80	1.70	0.99	0.78	1.00	0.23 U
CALCIUM, TOTAL	MG/KG	7580 J	7720 J	9350 J	3760 J	2930 J	7040 J
CHROMIUM, TOTAL	MG/KG	11.2	12.9	8.50	7.30	13.2	14
COBALT, TOTAL	MG/KG	12.1	10.8	10.5	11.1	9.90	20 J
COPPER, TOTAL	MG/KG	41.3	46.5	19.2	54.7	91.6	20.2
CYANIDE	MG/KG	0.42	0.47	0.29	0.20	0.45	0.43
IRON, TOTAL	MG/KG	16800 J	17000 J	12800 J	11100 J	14900 J	30900 J
LEAD, TOTAL	MG/KG	155 UJ	165 UJ	123 UJ	76 UJ	92.2 UJ	32.1 J
MAGNESIUM, TOTAL	MG/KG	1090	1160	1110	753	977	1610
MANGANESE, TOTAL	MG/KG	1070	1040	1040	1000	1040	839
MERCURY, TOTAL	MG/KG	0.13 U	0.14 U	0.13 U	0.13 U	0.12 U	0.12 U
NICKEL, TOTAL	MG/KG	13.6	13.6	11.5	13.3	12.7	28.2
POTASSIUM, TOTAL	MG/KG	891 U	862 U	864 U	628 U	911 U	2140
SELENIUM, TOTAL	MG/KG	0.60	0.62	0.50 U	0.50 U	0.48 U	0.68
SILVER, TOTAL	MG/KG	0.26 U	0.27 U	0.25 U	0.25 U	0.55	0.23 U
SODIUM, TOTAL	MG/KG	36.6 U	38.7 U	35.5 U	35.8 U	33.8 U	33.1 U
THALLIUM, TOTAL	MG/KG	0.52 U	0.55 U	0.50 U	0.50 U	0.48 U	0.57 U
VANADIUM, TOTAL	MG/KG	15.3	15.4	12.3	10.4	16	19.2 J

TABLE B-[illegible].2
ABG/JEP[illegible]IL SURFACE SOIL SAMPLES
1995 SOU[illegible]ST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03SS-A01	03SS-A01,DUP	03SS-A02	03SS-A03	03SS-A04	03SS-A05
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface
INORGANICS, cont.							
ZINC, TOTAL	MG/KG	166	169	71.6	130	301	131
SVOCs							
1,2,4-TRICHLOROBENZENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
1,2-DICHLOROBENZENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
1,3-DICHLOROBENZENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
1,4-DICHLOROBENZENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
2,4,5-TRICHLOROPHENOL	UG/KG	1100 U	23000 U	980 U	1000 U	960 U	920 U
2,4,6-TRICHLOROPHENOL	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
2,4-DICHLOROPHENOL	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
2,4-DIMETHYLPHENOL	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
2,4-DINITROPHENOL	UG/KG	1100 U	23000 U	980 U	1000 U	960 U	920 U
2-CHLORONAPHTHALENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
2-CHLOROPHENOL	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
2-METHYL-4,6-DINITROPHENOL	UG/KG	1100 U	23000 U	980 U	1000 U	960 U	920 U
2-METHYLNAPHTHALENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
2-METHYLPHENOL (O-CRESOL)	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
2-NITROANILINE	UG/KG	1100 U	23000 U	980 U	1000 U	960 U	920 U
2-NITROPHENOL	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
3,3'-DICHLOROBENZIDINE	UG/KG	460 U	9600 UJ	400 U	420 U	400 U	380 U
3-NITROANILINE	UG/KG	1100 U	23000 U	980 U	1000 U	960 U	920 U
4-BROMOPHENYL PHENYL ETHER	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
4-CHLORO-3-METHYLPHENOL	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
4-CHLOROANILINE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
4-CHLOROPHENYL PHENYL ETHER	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
4-METHYLPHENOL (P-CRESOL)	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
4-NITROANILINE	UG/KG	1100 U	23000 U	980 U	1000 U	960 U	920 U
4-NITROPHENOL	UG/KG	1100 U	23000 UJ	980 U	1000 U	960 U	920 U
ACENAPHTHENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
ACENAPHTHYLENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
ANTHRACENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
BENZO(A)ANTHRACENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
BENZO(A)PYRENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
BENZO(B)FLUORANTHENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
BENZO(G,H,I)PERYLENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
BENZO(K)FLUORANTHENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
BIS(2-CHLOROETHOXY)METHANE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
BIS(2-CHLOROETHYL) ETHER	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	460 BU	9600 U	400 BU	420 BU	400 BU	380 BU

TABLE B-1.a.2
ABG/JEEP TRAIL SURFACE SOIL SAMPLES
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME ANALYTES	UNITS	03SS-A01 Surface	03SS-A01,DUP Surface	03SS-A02 Surface	03SS-A03 Surface	03SS-A04 Surface	03SS-A05 Surface
VOCs, cont.							
BUTYLBENZYLPHTHALATE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
CARBAZOLE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
CHRYSENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
DI-N-BUTYL PHTHALATE	UG/KG	46 J	56000	130 J	50 J	1000	24 J
DI-N-OCTYL PHTHALATE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
DIBENZO(A,H)ANTHRACENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
DIBENZOFURAN	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
DIETHYL PHTHALATE	UG/KG	460 U	9600 U	400 U	23 J	400 U	380 U
DIMETHYL PHTHALATE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
FLUORANTHENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
FLUORENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
HEXACHLOROBENZENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
HEXACHLOROBUTADIENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
HEXACHLOROCYCLOPENTADIENE	UG/KG	460 UJ	9600 U	400 UJ	420 UJ	400 UJ	380 UJ
HEXACHLOROETHANE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
INDENO(1,2,3-CD)PYRENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
ISOPHORONE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
N-NITROSO-DI-N-PROPYLAMINE	UG/KG	460 U	9600 UJ	400 U	420 U	400 U	380 U
N-NITROSODIPHENYLAMINE	UG/KG	460 U	8100 J	400 U	420 U	48 J	380 U
NAPHTHALENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
PENTACHLOROPHENOL	UG/KG	1100 U	23000 U	980 U	1000 U	960 U	920 U
PHENANTHRENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
PHENOL	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U
PYRENE	UG/KG	460 U	9600 U	400 U	420 U	400 U	380 U

TABLE [illegible]c.1a
ABG SURFACE WATER SAMPLE RESULTS
1995 - 1996 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SW-01	03-SW-12	03-SW-13	03-SW-13,D	03-SW-14	03-SW-15
DATE	UNITS	1996	1996	1996	1996	1995	1996
EXPLOSIVES							
1,3-DINITROBENZENE	UG/L	4 UJ	4 UJ	4 UJ	4 UJ	4.00 U	4 UJ
1,3,5-TRINITROBENZENE	UG/L	7.3 UJ	7.3 UJ	7.3 UJ	7.3 UJ	7.30 U	7.3 UJ
2,4-DINITROTOLUENE	UG/L	5.7 UJ	5.7 UJ	5.7 UJ	5.7 UJ	5.70 U	5.7 UJ
2,4-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-TRINITROTOLUENE (TNT)	UG/L	6.4 UJ	6.4 UJ	6.4 UJ	6.4 UJ	6.40 U	6.4 UJ
2,6-DINITROTOLUENE	UG/L	9.4 UJ	9.4 UJ	9.4 UJ	9.4 UJ	9.40 U	9.4 UJ
2,6-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
HMX	UG/L	13 UJ	13 UJ	24 J	30 J	13 U	13 UJ
M-NITROTOLUENE	UG/L	7.9 UJ	7.9 UJ	7.9 UJ	7.9 UJ	7.90 U	7.9 UJ
NITROBENZENE	UG/L	7 UJ	7 UJ	7 UJ	7 UJ	7.00 U	7 UJ
NITROBENZENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
O-NITROTOLUENE	UG/L	12 UJ	12 UJ	12 UJ	12 UJ	12 U	12 UJ
P-NITROTOLUENE	UG/L	8 UJ	8 UJ	8 UJ	8 UJ	8.00 U	8 UJ
RDX	UG/L	14 UJ	14 UJ	14 UJ	14 UJ	14 U	14 UJ
TETRYL	UG/L	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 UJ
INORGANICS							
ALUMINUM, TOTAL	UG/L	335 J	732 J	104 J	107 J	318 J	112 J
ANTIMONY, TOTAL	UG/L	2 U	2 U	2 U	2.3 U	3.00 UJ	2.4 U
ARSENIC, TOTAL	UG/L	4.2 U	3.7 U	3 U	3 U	2.00 UJ	3 U
BARIUM, TOTAL	UG/L	47.3	221	111	114	57.2 J	115
BERYLLIUM, TOTAL	UG/L	1 U	1 U	1 U	1 U	1.00 UJ	1 U
CADMIUM, TOTAL	UG/L	1 U	1 U	1 U	1 U	1.00 UJ	1 U
CALCIUM, TOTAL	UG/L	6700 J	44900 J	33600 J	34400 J	11700 J	34400 J
CHROMIUM, TOTAL	UG/L	1 U	2.3	1 U	1 U	1.00 UJ	1 U
COBALT, TOTAL	UG/L	5.8 U	5.1 U	8.4 U	9 U	1.20 J	9.3 U
COPPER, TOTAL	UG/L	2 U	6.7	2 U	2 U	1.10 J	2 U
CYANIDE	UG/L	9	2.6	2.8	2 U	3.00 UJ	2 U

TABLE B-1.c.1a
ABG SURFACE WATER SAMPLE RESULTS
1995 - 1996 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SW-01	03-SW-12	03-SW-13	03-SW-13,D	03-SW-14	03-SW-15
DATE	UNITS	1996	1996	1996	1996	1995	1996
INORGANICS(CONT'D..)							
IRON, TOTAL	UG/L	488	1090	117	165	451 J	173
LEAD, TOTAL	UG/L	1 U	2.4	1 U	1 U	1.00 UJ	1 U
MAGNESIUM, TOTAL	UG/L	4300 J	12300 J	5780 J	5930 J	6680 J	5930 J
MANGANESE, TOTAL	UG/L	14.5 J	101 J	12.3 J	12.6 J	287 J	12.6 J
MERCURY, TOTAL	UG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.20 UJ	0.2 U
NICKEL, TOTAL	UG/L	3 U	5.2 U	1.1 U	1.5 U	4.70 J	2.1 U
POTASSIUM, TOTAL	UG/L	908	1910	1000	1060	2560 J	1070
SELENIUM, TOTAL	UG/L	3 U	3 U	3 U	3 U	2.00 UJ	3 U
SILVER, TOTAL	UG/L	2 U	2 U	2 U	2 U	1.00 UJ	2 U
THALLIUM, TOTAL	UG/L	4 UJ	4 UJ	4 UJ	4 UJ	2.10 J	4 UJ
VANADIUM, TOTAL	UG/L	1.2	1.3	1 U	1 U	1.00 UJ	1 U
ZINC, TOTAL	UG/L	10 U	20.5 U	7.9 U	7.5 U	6.20 UJ	7.3 U
SVOCs							
1,2-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-TRICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
1,3-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
1,4-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2-CHLORONAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2-CHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2-METHYL-4,6-DINITROPHENOL	UG/L	25 UJ	25 UJ	25 UJ	25 UJ	25 U	25 UJ
2-METHYLNAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2-METHYLPHENOL (O-CRESOL)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2-NITROANILINE	UG/L	25 U	25 U	25 U	25 U	25 U	25 U
2-NITROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DIMETHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DINITROPHENOL	UG/L	25 U	25 U	25 U	25 U	25 U	25 U

TABLE [illegible]c.1a
ABG SURFACE WATER SAMPLE RESULTS
1995 - 1996 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SW-01	03-SW-12	03-SW-13	03-SW-13,D	03-SW-14	03-SW-15
DATE	UNITS	1996	1996	1996	1996	1995	1996
SVOCs(CONT'D..)							
2,4,5-TRICHLOROPHENOL	UG/L	25 U	25 U	25 U	25 U	25 U	25 U
2,4,6-TRICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
3-NITROANILINE	UG/L	25 U	25 U	25 U	25 U	25 U	25 U
3,3'-DICHLOROBENZIDINE	UG/L	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
4-BROMOPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLORO-3-METHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLOROANILINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLOROPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
4-METHYLPHENOL (P-CRESOL)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
4-NITROANILINE	UG/L	25 U	25 U	25 U	25 U	25 U	25 U
4-NITROPHENOL	UG/L	25 U	25 U	25 U	25 U	25 UJ	25 U
ACENAPHTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
ACENAPHTHYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(A)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(A)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(B)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(G,H,I)PERYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(K)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHOXY)METHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHYL) ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	10 BU	10 BU	10 BU	10 BU	10 U	10 U
BUTYLBENZYLPHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
CARBAZOLE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
CHRYSENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
DIBENZOFURAN	UG/L	10 U	10 U	10 U	10 U	10 U	10 U

TABLE B-1.c.1a
ABG SURFACE WATER SAMPLE RESULTS
1995 - 1996 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SW-01	03-SW-12	03-SW-13	03-SW-13,D	03-SW-14	03-SW-15
DATE	UNITS	1996	1996	1996	1996	1995	1996
SVOCs(CONT'D..)							
DIBENZO(A,H)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
DIETHYL PHTHALATE	UG/L	10 U	0.7 J	10 U	10 U	10 U	10 U
DIMETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
DI-N-BUTYL PHTHALATE	UG/L	10 U	1 U	10 U	10 U	10 U	10 U
DI-N-OCTYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
FLUORENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBUTADIENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROCYCLOPENTADIENE	UG/L	10 U	10 U	10 U	10 U	10 UJ	10 U
HEXACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
INDENO(1,2,3-CD)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
ISOPHORONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
NAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSO-DI-N-PROPYLAMINE	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U
N-NITROSODIPHENYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
PENTACHLOROPHENOL	UG/L	25 U	25 U	25 U	25 U	25 U	25 U
PHENANTHRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
PHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
VOCs							
1,1-DICHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
1,1-DICHLOROETHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
1,1,1-TRICHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2-TRICHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
1,1,2,2-TETRACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U

TABLE B[illegible]c.1a
ABG SURFACE WATER SAMPLE RESULTS
1995 - 1996 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SW-01	03-SW-12	03-SW-13	03-SW-13,D	03-SW-14	03-SW-15
DATE	UNITS	1996	1996	1996	1996	1995	1996
VOCs(CONT'D..)							
1,2-DICHLOROETHENE(TOTAL)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROPROPANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2-BUTANONE (MEK)	UG/L	10 U	10 U	10 U	10 U	10 UJ	10 U
2-HEXANONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
4-METHYL-2-PENTANONE (MIBK)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
ACETONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BROMOFORM	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BROMOMETHANE (METHYL BROMIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
CARBON DISULFIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
CARBON TETRACHLORIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 UJ	10 U
CHLOROFORM	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
CHLOROMETHANE (METHYL CHLORI	UG/L	10 U	10 U	10 U	10 U	10 UJ	10 U
CIS-1,3-DICHLOROPROPENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
DIBROMOCHLOROMETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
ETHYLBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
METHYLENE CHLORIDE	UG/L	10 U	10 U	10 U	10 U	10 BU	10 U
STYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
TETRACHLOROETHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
TOLUENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
TRANS-1,3-DICHLOROPROPENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
TRICHLOROETHENE	UG/L	10 U	10 U	10 U	10 U	12	10 U
VINYL CHLORIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
XYLENE, TOTAL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U

TABLE B-1.c.1a
ABG SURFACE WATER SAMPLE RESULTS
1995 - 1996 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SW-01	03-SW-12	03-SW-13	03-SW-13,D	03-SW-14	03-SW-15
DATE	UNITS	1996	1996	1996	1996	1995	1996
WATER QUALITY PARAMETER							
ALKALINITY	MG/L	20 U	145	97	95	22	20 U
CHEMICAL OXYGEN DEMAND	MG/L	10 U	10 U	10 U	10 U	117	10 U
CHLORIDE	MG/L	1.4	3.7	2	2	1.40	1.4
NITROGEN (NO2+NO3)	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.10 U	0.1 U
SODIUM, TOTAL	UG/L	1850 J	4550 J	2270 J	2290 J	3340 J	2280 J
SULFATE	MG/L	28	20.4	20.6	20.7	36.3	27
TOTAL DISSOLVED SOLIDS	MG/L	65	193	141	137	120	70

TABLE [illegible]c.1b
ABG LITTLE SULPHUR CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SED-1	03-SED-12	03-SED-12,D	03-SED-13	03-SED-14	03-SED-15
ANALYTES	UNITS	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
EXPLOSIVES							
1,3-DINITROBENZENE	UG/KG	250 U	250 U		250 U	250 U	250 U
1,3,5-TRINITROBENZENE	UG/KG	250 U	250 U		250 U	250 UR	250 U
2,4-DINITROTOLUENE	UG/KG	370 U	370 U		350 U	410 U	380 U
2,4-DINITROTOLUENE,(2)	UG/KG	250 U	250 U		250 U	250 U	250 U
2,4,6-TRINITROTOLUENE (TNT)	UG/KG	250 U	250 U		250 U	250 UJ	250 U
2,6-DINITROTOLUENE	UG/KG	370 U	370 U		350 U	410 U	380 U
2,6-DINITROTOLUENE,(2)	UG/KG	260 U	260 U		260 U	260 U	260 U
HMX	UG/KG	2200 U	2200 U		2200 U	2200 U	2200 U
M-NITROTOLUENE	UG/KG	250 U	250 U		250 U	250 U	250 U
NITROBENZENE	UG/KG	370 UJ	370 UJ		350 U	410 U	380 UJ
NITROBENZENE,(2)	UG/KG	260 U	260 U		260 U	260 U	260 U
O-NITROTOLUENE	UG/KG	250 U	250 U		250 U	250 U	250 U
P-NITROTOLUENE	UG/KG	250 U	250 U		250 U	250 U	250 U
RDX	UG/KG	1000 U	1000 U		1000 U	1000 U	1000 U
TETRYL	UG/KG	650 U	650 U		650 U	650 U	650 U
INORGANICS							
ALUMINUM, TOTAL	MG/KG	6400 J	11200 J		8330 J	7210 J	6370 J
ANTIMONY, TOTAL	MG/KG	3.40 J	1.40 J		4.30 J	2.30 J	3.20 J
ARSENIC, TOTAL	MG/KG	42.1 J	19.8 J		62 J	32.5	37 J
BARIUM, TOTAL	MG/KG	55.4 J	373 J		262 J	68.1	77.9 J
BERYLLIUM, TOTAL	MG/KG	1.20 J	0.94 J		1.90 J	2.40	1.90 J
CADMIUM, TOTAL	MG/KG	0.22 UJ	0.22 UJ		0.24 J	0.25 U	0.23 UJ
CALCIUM, TOTAL	MG/KG	896 J	3060 J		14600 J	822 J	579 J
CHROMIUM, TOTAL	MG/KG	57.7 J	35.7 J		61.9 J	52.5	45.3 J
COBALT, TOTAL	MG/KG	17.7 J	27.9 J		21.8 J	41.1	47.3 J
COPPER, TOTAL	MG/KG	15.6 J	32.2 J		46.5 J	15.5 J	16.7 J
CYANIDE	MG/KG	0.17 UJ	0.40 J		0.39 J	0.19 UR	0.17 UJ

TABLE B-1.c.1b
ABG LITTLE SULPHUR CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SED-1	03-SED-12	03-SED-12,D	03-SED-13	03-SED-14	03-SED-15
ANALYTES	UNITS	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
INORGANICS, cont.							
IRON, TOTAL	MG/KG	108000 J	44100 J		107000 J	67000 J	101000 J
LEAD, TOTAL	MG/KG	35.6 J	29.4 J		284 J	41.1 J	35 J
MAGNESIUM, TOTAL	MG/KG	439 J	565 J		2210 J	694	879 J
MANGANESE, TOTAL	MG/KG	1010 J	2930 J		1440 J	2260 J	2200 J
MERCURY, TOTAL	MG/KG	0.13 J	0.11 UJ		0.11 UJ	0.13 U	0.12 UJ
NICKEL, TOTAL	MG/KG	27.1 J	26 J		42.3 J	44.6	68.1 J
POTASSIUM, TOTAL	MG/KG	1050 J	919 J		1460 J	812 U	1140 UJ
SELENIUM, TOTAL	MG/KG	2.80 J	0.44 UJ		1.80 J	0.92	1.50 J
SILVER, TOTAL	MG/KG	0.22 UJ	0.31 UJ		0.29 UJ	0.25 U	0.30 J
THALLIUM, TOTAL	MG/KG	7.50 J	1.90 J		7.40 J	2.10 U	5.10 J
VANADIUM, TOTAL	MG/KG	50.4 J	29.1 J		58.3 J	52.3	45.7 J
ZINC, TOTAL	MG/KG	74.4 J	131 J		861 J	88.1 J	82.1 J
SVOCs							
1,2-DICHLOROBENZENE	UG/KG	370 U	370 U		350 U	410 U	380 U
1,2,4-TRICHLOROBENZENE	UG/KG	370 U	370 U		350 U	410 U	380 U
1,3-DICHLOROBENZENE	UG/KG	370 U	370 U		350 U	410 U	380 U
1,4-DICHLOROBENZENE	UG/KG	370 U	370 U		350 U	410 U	380 U
2-CHLORONAPHTHALENE	UG/KG	370 U	370 U		350 U	410 U	380 U
2-CHLOROPHENOL	UG/KG	370 U	370 U		350 U	410 U	380 U
2-METHYL-4,6-DINITROPHENOL	UG/KG	890 U	890 U		860 U	1000 U	910 U
2-METHYLNAPHTHALENE	UG/KG	370 U	370 U		350 U	410 U	380 U
2-METHYLPHENOL (O-CRESOL)	UG/KG	370 U	370 U		350 U	410 U	380 U
2-NITROANILINE	UG/KG	890 UJ	890 UJ		860 UJ	1000 U	910 UJ
2-NITROPHENOL	UG/KG	370 U	370 U		350 U	410 U	380 U
2,4-DICHLOROPHENOL	UG/KG	370 U	370 U		350 U	410 U	380 U
2,4-DIMETHYLPHENOL	UG/KG	370 U	370 U		350 U	410 U	380 U
2,4-DINITROPHENOL	UG/KG	890 UJ	890 UJ		860 UJ	1000 U	910 UJ

TABLE B[illegible].c.1b
ABG LITTLE SULPHUR CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SED-1	03-SED-12	03-SED-12,D	03-SED-13	03-SED-14	03-SED-15
ANALYTES	UNITS	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
SVOCs, cont.							
2,4,5-TRICHLOROPHENOL	UG/KG	890 U	890 U		860 U	1000 U	910 U
2,4,6-TRICHLOROPHENOL	UG/KG	370 U	370 U		350 U	410 U	380 U
3-NITROANILINE	UG/KG	890 U	890 U		860 U	1000 U	910 U
3,3'-DICHLOROBENZIDINE	UG/KG	370 U	370 U		350 UJ	410 UJ	380 U
4-BROMOPHENYL PHENYL ETHER	UG/KG	370 U	370 U		350 U	410 U	380 U
4-CHLORO-3-METHYLPHENOL	UG/KG	370 U	370 U		350 U	410 U	380 U
4-CHLOROANILINE	UG/KG	370 U	370 U		350 U	410 U	380 U
4-CHLOROPHENYL PHENYL ETHER	UG/KG	370 U	370 U		350 U	410 U	380 U
4-METHYLPHENOL (P-CRESOL)	UG/KG	370 U	370 U		350 U	410 U	380 U
4-NITROANILINE	UG/KG	890 U	890 U		860 U	1000 U	910 U
4-NITROPHENOL	UG/KG	890 U	890 U		860 U	1000 UJ	910 U
ACENAPHTHENE	UG/KG	370 U	370 U		350 U	410 U	380 U
ACENAPHTHYLENE	UG/KG	370 U	370 U		350 U	410 U	380 U
ANTHRACENE	UG/KG	370 U	370 U		350 U	410 U	380 U
BENZO(A)ANTHRACENE	UG/KG	370 U	370 U		350 U	410 U	380 U
BENZO(A)PYRENE	UG/KG	370 U	370 U		350 U	410 U	380 U
BENZO(B)FLUORANTHENE	UG/KG	370 U	370 U		350 U	410 U	380 U
BENZO(G,H,I)PERYLENE	UG/KG	370 U	370 U		350 U	410 U	380 U
BENZO(K)FLUORANTHENE	UG/KG	370 U	370 U		350 U	410 U	380 U
BIS(2-CHLOROETHOXY)METHANE	UG/KG	370 U	370 U		350 UJ	410 U	380 U
BIS(2-CHLOROETHYL) ETHER	UG/KG	370 UJ	370 UJ		350 UJ	410 U	380 UJ
BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	370 UJ	370 UJ		350 UJ	410 U	380 UJ
BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	370 BU	370 BU		350 BU	410 BU	380 BU
BUTYLBENZYLPHTHALATE	UG/KG	370 U	370 U		350 U	22 J	380 U
CARBAZOLE	UG/KG	370 U	370 U		350 U	410 U	380 U
CHRYSENE	UG/KG	370 U	370 U		350 U	410 U	380 U
DIBENZOFURAN	UG/KG	370 U	370 U		350 U	410 U	380 U

TABLE B-1.c.1b
ABG LITTLE SULPHUR CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SED-1	03-SED-12	03-SED-12,D	03-SED-13	03-SED-14	03-SED-15
ANALYTES	UNITS	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
SVOCs, cont.							
DIBENZO(A,H)ANTHRACENE	UG/KG	370 U	370 U		350 U	410 U	380 U
DIETHYL PHTHALATE	UG/KG	370 U	370 U		350 U	410 U	380 U
DIMETHYL PHTHALATE	UG/KG	370 U	370 U		350 U	410 U	380 U
DI-N-BUTYL PHTHALATE	UG/KG	87 J	32 J		36 J	23 J	25 J
DI-N-OCTYL PHTHALATE	UG/KG	370 U	370 U		350 U	410 U	380 U
FLUORANTHENE	UG/KG	370 U	370 U		350 U	410 U	380 U
FLUORENE	UG/KG	370 U	370 U		350 U	410 U	380 U
HEXACHLOROBENZENE	UG/KG	370 U	370 U		350 U	410 U	380 U
HEXACHLOROBUTADIENE	UG/KG	370 U	370 U		350 U	410 U	380 U
HEXACHLOROCYCLOPENTADIENE	UG/KG	370 U	370 U		350 U	410 UJ	380 U
HEXACHLOROETHANE	UG/KG	370 U	370 U		350 U	410 U	380 U
INDENO(1,2,3-CD)PYRENE	UG/KG	370 U	370 U		350 U	410 U	380 U
ISOPHORONE	UG/KG	370 U	370 U		350 U	410 U	380 U
NAPHTHALENE	UG/KG	370 U	370 U		350 U	410 U	380 U
N-NITROSO-DI-N-PROPYLAMINE	UG/KG	370 UJ	370 UJ		350 UJ	410 U	380 UJ
N-NITROSODIPHENYLAMINE	UG/KG	370 U	370 U		350 U	410 U	380 U
PENTACHLOROPHENOL	UG/KG	890 U	890 U		860 U	1000 U	910 U
PHENANTHRENE	UG/KG	370 U	370 U		350 U	410 U	380 U
PHENOL	UG/KG	370 UJ	370 UJ		350 UJ	410 U	380 UJ
PYRENE	UG/KG	370 U	370 U		350 U	410 U	380 U
VOCs							
1,1-DICHLOROETHANE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
1,1-DICHLOROETHENE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
1,1,1-TRICHLOROETHANE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
1,1,2-TRICHLOROETHANE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
1,1,2,2-TETRACHLOROETHANE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
1,2-DICHLOROETHANE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ

TABLE [illegible].c.1b
ABG LITTLE SULPHUR CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SED-1	03-SED-12	03-SED-12,D	03-SED-13	03-SED-14	03-SED-15
ANALYTES	UNITS	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
VOCs, cont.							
1,2-DICHLOROETHENE(TOTAL)	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
1,2-DICHLOROPROPANE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
2-BUTANONE (MEK)	UG/KG	11 UJ	11 UJ	1.00 J	8.00 J	12 U	4.00 J
2-HEXANONE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 UJ	11 UJ
4-METHYL-2-PENTANONE (MIBK)	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
ACETONE	UG/KG	7.00 J	4.00 J	10 J	24 J	10 J	10 J
BENZENE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
BROMODICHLOROMETHANE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
BROMOFORM	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
BROMOMETHANE (METHYL BROMIDE)	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
CARBON DISULFIDE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
CARBON TETRACHLORIDE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
CHLOROBENZENE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
CHLOROETHANE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
CHLOROFORM	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
CHLOROMETHANE(METHYL CHLORIDE)	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
CIS-1,3-DICHLOROPROPENE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
DIBROMOCHLOROMETHANE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
ETHYLBENZENE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
METHYLENE CHLORIDE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	14 BU	11 BUJ
STYRENE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
TETRACHLOROETHENE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
TOLUENE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
TRANS-1,3-DICHLOROPROPENE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
TRICHLOROETHENE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
VINYL CHLORIDE	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	12 U	11 UJ
XYLENE, TOTAL	UG/KG	11 UJ	11 UJ	12 UJ	11 UJ	2.00 J	11 UJ

TABLE B-1.c.1b
ABG LITTLE SULPHUR CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SED-1	03-SED-12	03-SED-12,D	03-SED-13	03-SED-14	03-SED-15
ANALYTES	UNITS	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
WATER QUALITY PARAMETER							
NITROGEN (NO2+NO3)	MG/KG	1.88	1.12		1.18	1.25 U	1.48
SODIUM, TOTAL	MG/KG	60.2 UJ	77.9 UJ		41.6 UJ	39.7	51.1 UJ

TABLE B[illegible]d.1
ABG-SP[illegible]ATER SAMPLE RESULTS
1995 SO[illegible]ST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SPRING-A	03-SPRING-B	03-SPRING-C	03-SPRING-C,D	03-SPRING-08	03-SPRING-09
ANALYTES	UNITS	Spring	Spring	Spring	Spring	Spring	Spring
EXPLOSIVES							
1,3-DINITROBENZENE	UG/L	4.00 UJ	4.00 UJ	4.00 U	4.00 U	4.00 U	4.00 U
1,3,5-TRINITROBENZENE	UG/L	7.30 UJ	7.30 UJ	7.30 U	7.30 U	7.30 U	7.30 U
2,4-DINITROTOLUENE	UG/L	5.70 UJ	5.70 UJ	5.70 U	5.70 U	5.70 U	5.70 U
2,4-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-TRINITROTOLUENE (TNT)	UG/L	6.40 UJ	6.40 UJ	6.40 U	6.40 U	6.40 U	6.40 U
2,6-DINITROTOLUENE	UG/L	9.40 UJ	9.40 UJ	9.40 U	9.40 U	9.40 U	9.40 U
2,6-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
HMX	UG/L	13 UJ	38.3 J	13 U	13 U	13 U	13 U
M-NITROTOLUENE	UG/L	7.90 UJ	7.90 UJ	7.90 U	7.90 U	7.90 U	7.90 U
NITROBENZENE	UG/L	7.00 UJ	7.00 UJ	7.00 U	7.00 U	7.00 U	7.00 U
NITROBENZENE(2)	UG/L	10 UJ	10 U	10 U	10 U	10 UJ	10 UJ
O-NITROTOLUENE	UG/L	12 UJ	12 UJ	12 U	12 U	12 U	12 U
P-NITROTOLUENE	UG/L	8.00 UJ	8.00 UJ	8.00 U	8.00 U	8.00 U	8.00 U
RDX	UG/L	14 UJ	156 J	14 U	14 U	14 U	14 U
TETRYL	UG/L	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 U
INORGANICS							
ALUMINUM, TOTAL	UG/L	68.4 J	1620 J	31.6 UJ	18.6 UJ	22.3	224
ANTIMONY, TOTAL	UG/L	3.00 UJ	3.00 UJ	3.00 UJ	3.00 UJ	4.20	3.00 U
ARSENIC, TOTAL	UG/L	3.20 J	2.90 J	2.50 J	2.00 UJ	2.00 U	2.00 U
BARIUM, TOTAL	UG/L	136 J	105 J	70 J	68.9 J	54.5	76.4
BERYLLIUM, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 U
CADMIUM, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 U
CALCIUM, TOTAL	UG/L	67700 J	58900 J	64200 J	62600 J	56600 J	52800 J
CHROMIUM, TOTAL	UG/L	1.00 UJ	3.10 J	2.10 UJ	2.00 UJ	1.00 U	1.00 U
COBALT, TOTAL	UG/L	1.00 UJ	3.10 J	1.00 UJ	1.00 UJ	1.00 U	1.00 U
COPPER, TOTAL	UG/L	1.50 J	6.60 J	1.00 UJ	1.00 UJ	1.60	1.00 U
CYANIDE	UG/L	3.00 UJ	3.00 UJ	3.00 UJ	3.00 UJ	3.00 U	3.00 U
IRON, TOTAL	UG/L	108 J	3720 J	46.8 UJ	16.9 UJ	20.2	401
LEAD, TOTAL	UG/L	1.00 UJ	3.90 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 U
MAGNESIUM, TOTAL	UG/L	15900 J	18300 J	13400 J	13200 J	14500	9410
MANGANESE, TOTAL	UG/L	9.20 J	213 J	3.80 J	2.30 J	1.90	15
MERCURY, TOTAL	UG/L	0.20 UJ	0.20 UJ	0.69 J	0.20 UJ	0.2 UJ	0.2 UJ
NICKEL, TOTAL	UG/L	1.40 J	6.00 J	1.00 UJ	1.40 UJ	2.00	1.00 U
POTASSIUM, TOTAL	UG/L	4090 J	4600 J	2620 UJ	2880 UJ	2170	3210
SELENIUM, TOTAL	UG/L	2.10 J	2.00 UJ	2.00 UJ	2.00 UJ	2.00 U	2.00 U
SILVER, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 U
THALLIUM, TOTAL	UG/L	4.50 J	2.00 UJ	2.00 UJ	2.00 UJ	2.00 U	2.00 U
VANADIUM, TOTAL	UG/L	1.00 UJ	4.80 J	1.00 UJ	1.00 UJ	1.00 U	1.00 U
ZINC, TOTAL	UG/L	6.30 UJ	14.8 J	3.10 UJ	4.20 UJ	8.50 J	6.10 J

TABLE B-2.c.1a
ABG/JEEP TRAIL SPRING WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SPRING-A	03-SPRING-B	03-SPRING-C	03-SPRING-C,D	03-SPRING-08	03-SPRING-09
ANALYTES	UNITS	Spring	Spring	Spring	Spring	Spring	Spring
SVOCs							
1,2-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
1,2,4-TRICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
1,3-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
1,4-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2-CHLORONAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2-CHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2-METHYL-4,6-DINITROPHENOL	UG/L	25 U	25 U	25 U	25 U	25 U	25 U
2-METHYLNAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2-METHYLPHENOL (O-CRESOL)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2-NITROANILINE	UG/L	25 UJ	25 UJ	25 U	25 U	25 UJ	25 UJ
2-NITROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DIMETHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
2,4-DINITROPHENOL	UG/L	25 UJ	25 UJ	25 U	25 U	25 UJ	25 UJ
2,4,5-TRICHLOROPHENOL	UG/L	25 U	25 U	25 U	25 U	25 U	25 U
2,4,6-TRICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
3-NITROANILINE	UG/L	25 U	25 U	25 U	25 U	25 U	25 U
3,3'-DICHLOROBENZIDINE	UG/L	10 U	10 UJ	10 U	10 U	10 U	10 U
4-BROMOPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLORO-3-METHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLOROANILINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
4-CHLOROPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
4-METHYLPHENOL (P-CRESOL)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
4-NITROANILINE	UG/L	25 U	25 U	25 UJ	25 UJ	25 U	25 U
4-NITROPHENOL	UG/L	25 U	25 U	25 U	25 U	25 U	25 U
ACENAPHTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
ACENAPHTHYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(A)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(A)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(B)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(G,H,I)PERYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BENZO(K)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHOXY)METHANE	UG/L	10 U	10 UJ	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHYL) ETHER	UG/L	10 UJ	10 UJ	10 U	10 U	10 UJ	10 UJ
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 UJ	10 UJ	10 U	10 U	10 UJ	10 UJ
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
BUTYLBENZYLPHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
CARBAZOLE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U

TABLE B-2 c.1a
ABG/JE[illegible]L SPRING WATER SAMPLE RESULTS
1995 SO[illegible]T LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SPRING-A	03-SPRING-B	03-SPRING-C	03-SPRING-C,D	03-SPRING-08	03-SPRING-09
ANALYTES	UNITS	Spring	Spring	Spring	Spring	Spring	Spring
SVOCs, cont.							
CHRYSENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
DIBENZOFURAN	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
DIBENZO(A,H)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
DIETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
DIMETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
DI-N-BUTYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	0.6 J	0.8 J
DI-N-OCTYL PHTHALATE	UG/L	10 U	10 U	10 UJ	10 UJ	10 U	10 U
FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
FLUORENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBUTADIENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROCYCLOPENTADIENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
HEXACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
INDENO(1,2,3-CD)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
ISOPHORONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
NAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
N-NITROSO-DI-N-PROPYLAMINE	UG/L	10 UJ	10 UJ	10 U	10 U	10 UJ	10 UJ
N-NITROSODIPHENYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
PENTACHLOROPHENOL	UG/L	25 U	25 U	25 U	25 U	25 U	25 U
PHENANTHRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
PHENOL	UG/L	10 U	10 UJ	10 U	10 U	10 U	10 U
PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U
VOCs							
1,1-DICHLOROETHANE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
1,1-DICHLOROETHENE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
1,1,1-TRICHLOROETHANE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
1,1,2-TRICHLOROETHANE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
1,1,2,2-TETRACHLOROETHANE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
1,2-DICHLOROETHENE(TOTAL)	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
1,2-DICHLOROPROPANE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
2-BUTANONE (MEK)	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
2-HEXANONE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
4-METHYL-2-PENTANONE (MIBK)	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
ACETONE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
BENZENE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
BROMOFORM	UG/L	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 U
BROMOMETHANE (METHYL BROMIDE)	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U

TABLE B-2.c.1a
ABG/JEEP TRAIL SPRING WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-SPRING-A	03-SPRING-B	03-SPRING-C	03-SPRING-C,D	03-SPRING-08	03-SPRING-09
ANALYTES	UNITS	Spring	Spring	Spring	Spring	Spring	Spring
VOCs, cont.							
CARBON DISULFIDE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	2.00 J
CARBON TETRACHLORIDE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
CHLOROBENZENE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
CHLOROETHANE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
CHLOROFORM	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
CHLOROMETHANE (METHYL CHLORIDE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
CIS-1,3-DICHLOROPROPENE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
DIBROMOCHLOROMETHANE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
ETHYLBENZENE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
METHYLENE CHLORIDE	UG/L	14 BUJ	20 BUJ	17 BU	12 BU	10 BU	10 BU
STYRENE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
TETRACHLOROETHENE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
TOLUENE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
TRANS-1,3-DICHLOROPROPENE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
TRICHLOROETHENE	UG/L	10 UJ	10 UJ	10 U	3.00 J	10 U	10 U
VINYL CHLORIDE	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
XYLENE, TOTAL	UG/L	10 UJ	10 UJ	10 U	10 U	10 U	10 U
WATER QUALITY PARAMETER							
ALKALINITY	MG/L	179	156	170	164	146	142
CHEMICAL OXYGEN DEMAND	MG/L	10 U	10 U	10 U	10 U	10 U	10 U
CHLORIDE	MG/L	8.40	2.20	3.30	3.40	1.70	1.30
NITROGEN (NO2+NO3)	MG/L	1.30	0.33	0.39	0.39	0.39	0.29
SODIUM, TOTAL	MG/L	9510 J	12500 J	5440 J	5760 J	6030	7620
SULFATE	MG/L	65.5	82	50.5	53.2	66.5	34.6
TOTAL DISSOLVED SOLIDS	MG/L	430	310	220	210	630	580

TABLE B-1 e.1
ABG GR[illegible]TER SAMPLE RESULTS
1995 S[illegible]T LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-12	03-12,R	03-15	03-24	03C17	03C17,D	03C34	03-07	03-07,DL
ANALYTES	UNITS	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	ALLUV	
EXPLOSIVES										
1,3-DINITROBENZENE	UG/L	4.00 U		4.00 U	4.00 U	4.00 U	4.00 U	4.00 U	4.00 U	
1,3,5-TRINITROBENZENE	UG/L	7.30 U		7.30 U	7.30 U	7.30 U	7.30 U	7.30 U	7.30 U	
2,4-DINITROTOLUENE	UG/L	5.70 U		5.70 U	5.70 U	5.70 U	5.70 U	5.70 U	5.70 U	
2,4-DINITROTOLUENE(OLM01.8)	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
2,4,6-TRINITROTOLUENE (TNT)	UG/L	6.40 U		6.40 U	6.40 U	6.40 U	6.40 U	6.40 U	6.40 U	
2,6-DINITROTOLUENE	UG/L	9.40 U		9.40 U	9.40 U	9.40 U	9.40 U	9.40 U	9.40 U	
2,6-DINITROTOLUENE(OLM01.8)	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
HMX	UG/L	55.2		13 U	13 U	13 U	13 U	13 U	13 U	
M-NITROTOLUENE	UG/L	7.90 U		7.90 U	7.90 U	7.90 U	7.90 U	7.90 U	7.90 U	
NITROBENZENE	UG/L	7.00 U		7.00 U	7.00 U	7.00 U	7.00 U	7.00 U	7.00 U	
NITROBENZENE(OLM01.8)	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	0.60 J	
O-NITROTOLUENE	UG/L	12 U		12 U	12 U	12 U	12 U	12 U	12 U	
P-NITROTOLUENE	UG/L	8.00 U		8.00 U	8.00 U	8.00 U	8.00 U	8.00 U	8.00 U	
RDX	UG/L	81.3 J		14 U	14 U	14 U	14 U	14 U	14 U	
TETRYL	UG/L	10 U		10 U	10 U	10 U	10 U	10 UJ	10 U	
INORGANICS										
ALUMINUM, TOTAL	UG/L	51400 J		14700 J	50200 J	968 J	933 J	21600 J	1890 J	
ANTIMONY, TOTAL	UG/L	6.40 UJ		3.00 UJ	4.70 UJ	3.00 UJ	3.00 UJ	3.00 UJ	3.00 UJ	
ARSENIC, TOTAL	UG/L	140 J		22.9 J	87.9 J	7.80 J	8.20 J	28.1 J	6.50 J	
BARIUM, TOTAL	UG/L	915 J		161 J	2300 J	29.9 J	23.5 J	221 J	59 J	
BERYLLIUM, TOTAL	UG/L	8.00 J		1.80 J	5.00 J	1.00 UJ	1.00 UJ	2.20 J	1.00 UJ	
CADMIUM, TOTAL	UG/L	6.90 J		1.40 J	6.10 J	1.10 J	1.00 UJ	1.00 UJ	1.00 UJ	
CALCIUM, TOTAL	UG/L	124000 J		112000 J	533000 J	205000 J	204000 J	75500 J	187000 J	
CHROMIUM, TOTAL	UG/L	77.3 J		57.1 J	82.5 J	11.3 J	7.90 J	68.6 J	21.4 J	
COBALT, TOTAL	UG/L	53.1 J		7.30 J	54.2 J	7.10 J	6.10 J	13.4 J	4.00 J	
COPPER, TOTAL	UG/L	71.2 J		19.1 J	79.9 J	7.00 J	4.90 J	27.7 J	12.5 J	
CYANIDE	UG/L	3.00 UJ		3.00 UJ	3.00 UJ	3.00 UJ	3.00 UJ	3.00 UJ	3.00 UJ	
IRON, TOTAL	UG/L	161000 J		34100 J	105000 J	2990 J	2580 J	35700 J	5460 J	
LEAD, TOTAL	UG/L	229 J		27 J	141 J	9.80 J	3.70 J	36.6 J	5.10 J	
MAGNESIUM, TOTAL	UG/L	21100 J		20400 J	47700 J	214000 J	216000 J	12800 J	331000 J	
MANGANESE, TOTAL	UG/L	14700 J		2000 J	7380 J	1140 J	1150 J	1300 J	5810 J	
MERCURY, TOTAL	UG/L	0.20 UJ		0.20 UJ	0.20 UJ	0.20 UJ	0.67 UJ	0.20 UJ	0.72 UJ	
NICKEL, TOTAL	UG/L	285 J		64.7 J	165 J	30.2 J	28 J	79.7 J	23.9 J	
POTASSIUM, TOTAL	UG/L	12900 J		8610 J	13600 J	6080 J	5950 J	6910 J	53900 J	
SELENIUM, TOTAL	UG/L	2.00 UJ		2.00 UJ	2.00 UJ	2.00 UJ	2.00 UJ	2.00 UJ	2.00 UJ	
SILVER, TOTAL	UG/L	1.00 UJ		1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.80 J	
THALLIUM, TOTAL	UG/L	5.70 UJ		3.50 UJ	3.90 UJ	4.30 UJ	2.70 UJ	2.00 UJ	3.10 UJ	
VANADIUM, TOTAL	UG/L	108 J		64.6 J	116 J	2.00 J	1.80 J	42.1 J	5.10 J	
ZINC, TOTAL	UG/L	748 J		182 J	901 J	15.7 J	11.6 J	270 J	24.2 J	

ABG GROUND WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME ANALYTES SVOCs	UNITS	03-12 BCH CRK	03-12,R BCH CRK	03-15 BCH CRK	03-24 BCH CRK	03C17 BCH CRK	03C17,D BCH CRK	03C34 BCH CRK	03-07 ALLUV	03-07,DL
1,2-DICHLOROBENZENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
1,2,4-TRICHLOROBENZENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
1,3-DICHLOROBENZENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
1,4-DICHLOROBENZENE	UG/L	10 UR	10 UR	10 U	10 U	0.60 J	0.60 J	10 U	10 U	
2-CHLORONAPHTHALENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
2-CHLOROPHENOL	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
2-METHYL-4,6-DINITROPHENOL	UG/L	25 UR	25 UR	25 U	25 U	25 U	25 U	25 U	25 U	
2-METHYLNAPHTHALENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
2-METHYLPHENOL (O-CRESOL)	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
2-NITROANILINE	UG/L	25 UR	25 UR	25 U	25 U	25 U	25 U	25 U	25 U	
2-NITROPHENOL	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
2,4-DICHLOROPHENOL	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
2,4-DIMETHYLPHENOL	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
2,4-DINITROPHENOL	UG/L	25 UR	25 UR	25 UJ	25 U	25 U	25 UJ	25 U	25 U	
2,4,5-TRICHLOROPHENOL	UG/L	25 UR	25 UR	25 U	25 U	25 U	25 U	25 U	25 U	
2,4,6-TRICHLOROPHENOL	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
3-NITROANILINE	UG/L	25 UR	25 UR	25 U	25 U	25 U	25 U	25 U	25 U	
3,3'-DICHLOROBENZIDINE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
4-BROMOPHENYL PHENYL ETHER	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
4-CHLORO-3-METHYLPHENOL	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
4-CHLOROANILINE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
4-CHLOROPHENYL PHENYL ETHER	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
4-METHYLPHENOL (P-CRESOL)	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
4-NITROANILINE	UG/L	25 UR	25 UR	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	
4-NITROPHENOL	UG/L	25 UR	25 UR	25 U	25 U	25 U	25 U	25 U	1.00 J	
ACENAPHTHENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
ACENAPHTHYLENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
ANTHRACENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
BENZO(A)ANTHRACENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
BENZO(A)PYRENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
BENZO(B)FLUORANTHENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
BENZO(G,H,I)PERYLENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
BENZO(K)FLUORANTHENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
BIS(2-CHLOROETHOXY)METHANE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
BIS(2-CHLOROETHYL) ETHER	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	10 BUR	10 BUR	10 BUJ	10 U	10 BU	10 BUJ	10 BU	10 BU	
BUTYLBENZYLPHTHALATE	UG/L	10 UR	10 UR	10 U	10 U	3.00 J	4.00 J	10 U	10 U	
CARBAZOLE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	

TABLE B-1.e.1
ABG GRO[illegible]ATER SAMPLE RESULTS
1995 SO[illegible]T LAB
RISK ASSE[illegible]MENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-12	03-12,R	03-15	03-24	03C17	03C17,D	03C34	03-07	03-07,DL
ANALYTES	UNITS	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	ALLUV	
SVOCs, cont.										
CHRYSENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
DIBENZOFURAN	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
DIBENZO(A,H)ANTHRACENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
DIETHYL PHTHALATE	UG/L	10 UR	10 UR	10 U	10 U	10 U	0.70 J	10 U	10 U	
DIMETHYL PHTHALATE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
DI-N-BUTYL PHTHALATE	UG/L	10 UR	1.00 J	10 U	10 U	10 U	10 U	10 U	10 U	
DI-N-OCTYL PHTHALATE	UG/L	10 UR	10 UR	10 U	10 UJ	10 UJ	10 U	10 UJ	10 UJ	
FLUORANTHENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
FLUORENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
HEXACHLOROBENZENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
HEXACHLOROBUTADIENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
HEXACHLOROCYCLOPENTADIENE	UG/L	10 UR	10 UR	10 UJ	10 U	10 U	10 UJ	10 U	10 U	
HEXACHLOROETHANE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
INDENO(1,2,3-CD)PYRENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
ISOPHORONE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
NAPHTHALENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
N-NITROSO-DI-N-PROPYLAMINE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
N-NITROSODIPHENYLAMINE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
PENTACHLOROPHENOL	UG/L	25 UR	25 UR	25 U	25 U	25 U	25 U	25 U	25 U	
PHENANTHRENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
PHENOL	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
PYRENE	UG/L	10 UR	10 UR	10 U	10 U	10 U	10 U	10 U	10 U	
VOCs										
1,1-DICHLOROETHANE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
1,1-DICHLOROETHENE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	7.00 J	200 U
1,1,1-TRICHLOROETHANE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
1,1,2-TRICHLOROETHANE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	59	50 JD
1,1,2,2-TETRACHLOROETHANE	UG/L	10 U		12	3.00 J	10 U	10 U	10 U	590 J	420 D
1,2-DICHLOROETHANE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
1,2-DICHLOROETHENE(TOTAL)	UG/L	10 U		5.00 J	8.00 J	10 U	10 U	10 U	1100 J	1200 D
1,2-DICHLOROPROPANE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
2-BUTANONE (MEK)	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
2-HEXANONE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
4-METHYL-2-PENTANONE (MIBK)	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
ACETONE	UG/L	10 U		14 U	10 U	10 U	10 U	10 U	10 U	200 U
BENZENE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
BROMODICHLOROMETHANE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
BROMOFORM	UG/L	10 UJ		10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	200 U
BROMOMETHANE (METHYL BROMIDE)	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U

TABLE B 1.e.1
ABG GROUND WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		03-12	03-12,R	03-15	03-24	03C17	03C17,D	03C34	03-07	03-07,DL
ANALYTES	UNITS	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	ALLUV	
VOCs, cont.										
CARBON DISULFIDE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
CARBON TETRACHLORIDE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
CHLOROBENZENE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
CHLOROETHANE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	7.00 J	200 U
CHLOROFORM	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	1.00 J	200 U
CHLOROMETHANE (METHYL CHLORIDE)	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
CIS-1,3-DICHLOROPROPENE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
DIBROMOCHLOROMETHANE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
ETHYLBENZENE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
METHYLENE CHLORIDE	UG/L	15 BU		30 BU	24 BU	21 BU	14 BU	14 BU	16 BU	200 U
STYRENE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
TETRACHLOROETHENE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	9.00 J	200 U
TOLUENE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
TRANS-1,3-DICHLOROPROPENE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
TRICHLOROETHENE	UG/L	5.00 J		12	16	10 U	10 U	10 U	2400 J	2200 D
VINYL CHLORIDE	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	18	200 U
XYLENE, TOTAL	UG/L	10 U		10 U	10 U	10 U	10 U	10 U	10 U	200 U
WATER QUALITY PARAMETER										
ALKALINITY	MG/L	205 J		239 J	810 J	505	497	174 J	497	
CHEMICAL OXYGEN DEMAND	MG/L	34.4		21.4	65	163	146	38.8	19.2	
CHLORIDE	MG/L	3.50		2.30	4.60	2.60	2.40	2.40	24.8	
NITROGEN (NO2+NO3)	MG/L	0.38		0.78	0.31	0.10 U	0.10 U	0.48	0.10 U	
SODIUM, TOTAL	MG/L	4740 J		3210 J	12800 J	111000 J	113000 J	6000 J	8750 J	
SULFATE	MG/L	59.6		84.6	150	1040	977	25.3	2010	
TOTAL DISSOLVED SOLIDS	MG/L	110 J		350 J	400 J	2020	1860	100 J	3440	
CYCLOHEXANE	MG/L			120 NJ						

TABLE B[illegible]
ORR BAC[illegible]D/TARGET AREA SURFACE SOIL SAMPLES
1995 SOUT[illegible]ST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		07SS-A01	07SS-A02	07SS-A03	07SS-A04	07SS-A05	07SS-A06
SAMPLE TYPE	UNITS	BKGRD	BKGRD	BKGRD	TARGET	TARGET	TARGET
EXPLOSIVES							
1,3,5-TRINITROBENZENE	UG/KG	250 UR	250 UR	250 UR	250 UR	250 UR	250 UR
1,3-DINITROBENZENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U
2,4,6-TRINITROTOLUENE (TNT)	UG/KG	250 UJ	250 UJ	250 UJ	250 UJ	2490 UJ	250 UJ
2,4-DINITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U
2,4-DINITROTOLUENE(2)	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
2,6-DINITROTOLUENE	UG/KG	260 U	260 U	260 U	260 U	260 U	260 U
2,6-DINITROTOLUENE(2)	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
HMX	UG/KG	2200 U	2200 U	2200 U	2200 U	2200 U	2200 U
M-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U
NITROBENZENE	UG/KG	260 U	260 U	260 U	260 U	260 U	260 U
NITROBENZENE(2)	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
O-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U
P-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U
RDX	UG/KG	1000 U	1000 U	1000 U	1000 U	1000 U	1000 U
TETRYL	UG/KG	650 U	650 U	650 U	650 U	650 U	650 U
INORGANICS							
ALUMINUM, TOTAL	MG/KG	4320 J	4250 J	4480 J	5210 J	6990 J	5050 J
ANTIMONY, TOTAL	MG/KG	0.70 UJ	0.72 UJ	0.77 UJ	0.76 UJ	0.67 UJ	0.69 UJ
ARSENIC, TOTAL	MG/KG	6.50	7.00	7.10	6.50	9.10	7.10
BARIUM, TOTAL	MG/KG	72.1	56.7	94.3	103	166	247
BERYLLIUM, TOTAL	MG/KG	0.62	0.52	0.73	0.85	0.63	0.81
CADMIUM, TOTAL	MG/KG	0.23 U	0.24 U	0.34	0.34	0.22 U	0.23 U
CALCIUM, TOTAL	MG/KG	592 J	433 J	1820 J	3330 J	5260 J	2490 J
CHROMIUM, TOTAL	MG/KG	11.6 J	10.9 J	7.60 J	10.5 J	11.7 J	11.2
COBALT, TOTAL	MG/KG	11.8	15.2	12.6	8.80	10.4	11.4
COPPER, TOTAL	MG/KG	9.20 J	10 J	14.4 J	15.4 J	14.4 J	12.5 J
CYANIDE	MG/KG	0.18 UR	0.18 UR	0.19 UR	0.19 UR	0.48 J	0.17 UR
IRON, TOTAL	MG/KG	12100 J	13200 J	12600 J	14700 J	17900 J	14300
LEAD, TOTAL	MG/KG	21.3 J	20.5 J	19.5 J	21.8 J	20.5 J	20.2 J
MAGNESIUM, TOTAL	MG/KG	387 J	333 J	740 J	810 J	1620 J	610
MANGANESE, TOTAL	MG/KG	1210 J	931 J	968 J	666 J	525 J	1120 J
MERCURY, TOTAL	MG/KG	0.12 U	0.12 U	0.13 U	0.13 U	0.11 U	0.11 U
NICKEL, TOTAL	MG/KG	8.00 J	7.30 J	15.5 J	12.4 J	14.1 J	10.9
POTASSIUM, TOTAL	MG/KG	651 U	666 U	812 U	1180 U	1520 J	918
SELENIUM, TOTAL	MG/KG	1.00	1.30	0.94	1.10	1.10	0.81
SILVER, TOTAL	MG/KG	0.33	0.24 U	0.26 U	0.25 U	0.22 U	0.23 U
SODIUM, TOTAL	MG/KG	54.9	40.3	36.3 U	73.4	73.9	32.5 U
THALLIUM, TOTAL	MG/KG	0.47 U	0.48 U	0.51 U	0.56	0.74	0.46 U
VANADIUM, TOTAL	MG/KG	13.6	14	12.8	15.9	19	15

TABLE B-2.a.1
ORR BACKGROUND/TARGET AREA SURFACE SOIL SAMPLES
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		07SS-A01	07SS-A02	07SS-A03	07SS-A04	07SS-A05	07SS-A06
SAMPLE TYPE	UNITS	BKGRD	BKGRD	BKGRD	TARGET	TARGET	TARGET
INORGANICS, cont.							
ZINC, TOTAL	MG/KG	24 J	22.8 J	39.1 J	30 J	37.8 J	45.6 J
SVOCs							
1,2,4-TRICHLOROBENZENE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
1,2-DICHLOROBENZENE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
1,3-DICHLOROBENZENE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
1,4-DICHLOROBENZENE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
2,4,5-TRICHLOROPHENOL	UG/KG	950 U	950 U	1000 U	990 U	1800 U	910 U
2,4,6-TRICHLOROPHENOL	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
2,4-DICHLOROPHENOL	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
2,4-DIMETHYLPHENOL	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
2,4-DINITROPHENOL	UG/KG	950 U	950 UJ	1000 UJ	990 UJ	1800 U	910 UJ
2-CHLORONAPHTHALENE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
2-CHLOROPHENOL	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
2-METHYL-4,6-DINITROPHENOL	UG/KG	950 U	950 U	1000 U	990 U	1800 U	910 U
2-METHYLNAPHTHALENE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
2-METHYLPHENOL (O-CRESOL)	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
2-NITROANILINE	UG/KG	950 U	950 U	1000 U	990 U	1800 U	910 U
2-NITROPHENOL	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
3,3'-DICHLOROBENZIDINE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
3-NITROANILINE	UG/KG	950 U	950 U	1000 U	990 U	1800 U	910 U
4-BROMOPHENYL PHENYL ETHER	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
4-CHLORO-3-METHYLPHENOL	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
4-CHLOROANILINE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
4-CHLOROPHENYL PHENYL ETHER	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
4-METHYLPHENOL (P-CRESOL)	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
4-NITROANILINE	UG/KG	950 U	950 U	1000 U	990 U	1800 U	910 U
4-NITROPHENOL	UG/KG	950 U	950 U	1000 U	990 U	1800 U	910 U
ACENAPHTHENE	UG/KG	390 U	390 U	430 U	410 U	130 J	380 U
ACENAPHTHYLENE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
ANTHRACENE	UG/KG	390 U	390 U	430 U	410 U	190 J	380 U
BENZO(A)ANTHRACENE	UG/KG	390 U	390 U	430 U	410 U	2500	77 J
BENZO(A)PYRENE	UG/KG	390 U	390 U	430 U	410 U	2800	100 J
BENZO(B)FLUORANTHENE	UG/KG	390 U	390 U	430 U	410 U	3700	99 J
BENZO(G,H,I)PERYLENE	UG/KG	390 U	390 U	430 U	410 U	2000	88 J
BENZO(K)FLUORANTHENE	UG/KG	390 U	390 U	430 U	410 U	1400	98 J
BIS(2-CHLOROETHOXY)METHANE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
BIS(2-CHLOROETHYL) ETHER	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	390 BU	390 BU	430 BU	410 BU	750 BU	380 BU

TABLE B[illegible].1
ORR BA[illegible]D/TARGET AREA SURFACE SOIL SAMPLES
1995 SO[illegible]T LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		07SS-A01	07SS-A02	07SS-A03	07SS-A04	07SS-A05	07SS-A06
SAMPLE TYPE	UNITS	BKGRD	BKGRD	BKGRD	TARGET	TARGET	TARGET
VOCs, cont.							
BUTYLBENZYLPHTHALATE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
CARBAZOLE	UG/KG	390 U	390 U	430 U	410 U	190 J	380 U
CHRYSENE	UG/KG	390 U	390 U	430 U	410 U	3100	100 J
DI-N-BUTYL PHTHALATE	UG/KG	390 U	390 U	430 U	410 U	750 U	21 J
DI-N-OCTYL PHTHALATE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
DIBENZO(A,H)ANTHRACENE	UG/KG	390 U	390 U	430 U	410 U	840	19 J
DIBENZOFURAN	UG/KG	390 U	390 U	430 U	410 U	40 J	380 U
DIETHYL PHTHALATE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
DIMETHYL PHTHALATE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
FLUORANTHENE	UG/KG	390 U	390 U	29 J	410 U	3100	99 J
FLUORENE	UG/KG	390 U	390 U	430 U	410 U	74 J	380 U
HEXACHLOROBENZENE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
HEXACHLOROBUTADIENE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
HEXACHLOROCYCLOPENTADIENE	UG/KG	390 UJ	390 UJ	430 UJ	410 UJ	750 UJ	380 UJ
HEXACHLOROETHANE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
INDENO(1,2,3-CD)PYRENE	UG/KG	390 U	390 U	430 U	410 U	2200	81 J
ISOPHORONE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
N-NITROSO-DI-N-PROPYLAMINE	UG/KG	390 UJ	390 UJ	430 UJ	410 UJ	750 U	380 UJ
N-NITROSODIPHENYLAMINE	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
NAPHTHALENE	UG/KG	390 U	390 U	430 U	410 U	100 J	380 U
PENTACHLOROPHENOL	UG/KG	950 U	950 U	1000 U	990 U	1800 U	910 U
PHENANTHRENE	UG/KG	390 U	390 U	430 U	410 U	910	28 J
PHENOL	UG/KG	390 U	390 U	430 U	410 U	750 U	380 U
PYRENE	UG/KG	390 U	390 U	25 J	410 U	2900	110 J

TABLE B-2.c.1a
ORR TURKEY CREEK SURFACE WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		07-SW-T1	07-SW-T2	06-SW-T3	06-SW-T3,D
ANALYTES	UNITS	SW	SW	SW	SW
EXPLOSIVES					
1,3-DINITROBENZENE	UG/L	4.00 U	4.00 U	4.00 UJ	4.00 UJ
1,3,5-TRINITROBENZENE	UG/L	7.30 U	7.30 U	7.30 UJ	7.30 UJ
2,4-DINITROTOLUENE	UG/L	5.70 U	5.70 U	5.70 UJ	5.70 UJ
2,4-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	10 U
2,4,6-TRINITROTOLUENE (TNT)	UG/L	6.40 U	6.40 U	6.40 UJ	6.40 UJ
2,6-DINITROTOLUENE	UG/L	9.40 U	9.40 U	9.40 UJ	9.40 UJ
2,6-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U	10 U
HMX	UG/L	13 U	13 U	13 UJ	13 UJ
M-NITROTOLUENE	UG/L	7.90 U	7.90 U	7.90 UJ	7.90 UJ
NITROBENZENE	UG/L	7.00 U	7.00 U	7.00 UJ	7.00 UJ
NITROBENZENE(2)	UG/L	10 U	10 U	10 U	10 U
O-NITROTOLUENE	UG/L	12 U	12 U	12 UJ	12 UJ
P-NITROTOLUENE	UG/L	8.00 U	8.00 U	8.00 UJ	8.00 UJ
RDX	UG/L	14 U	14 U	14 UJ	14 UJ
TETRYL	UG/L	10 UJ	10 U	10 UJ	10 UJ
INORGANICS					
ALUMINUM, TOTAL	UG/L	44.4 U	28.6 J	167 U	206 U
ANTIMONY, TOTAL	UG/L	3.00 U	3.00 UJ	3.00 U	3.00 U
ARSENIC, TOTAL	UG/L	3.00 U	2.00 UJ	3.00 U	3.00 U
BARIUM, TOTAL	UG/L	93	69.2 J	84.3	85.1
BERYLLIUM, TOTAL	UG/L	1.00 U	1.00 UJ	1.00 U	1.00 U
CADMIUM, TOTAL	UG/L	1.00 U	1.00 UJ	1.00 U	1.00 U
CALCIUM, TOTAL	UG/L	46000	50200 J	45400	45600
CHROMIUM, TOTAL	UG/L	1.00 U	1.00 UJ	1.00 U	1.00 U
COBALT, TOTAL	UG/L	1.00 U	1.00 UJ	1.00 U	1.30
COPPER, TOTAL	UG/L	2.00 U	1.30 J	3.50	3.90
CYANIDE	UG/L	3.00 U	3.00 UJ	3.00 U	3.00 U
IRON, TOTAL	UG/L	364	145 J	361 J	447 J
LEAD, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ	1.40 UJ
MAGNESIUM, TOTAL	UG/L	8560	9300 J	8260	8290
MANGANESE, TOTAL	UG/L	1030 J	72.9 J	414 J	408 J
MERCURY, TOTAL	UG/L	0.20 U	0.20 UJ	0.20 U	0.20 U
NICKEL, TOTAL	UG/L	2.70	1.00 UJ	2.10	2.40
POTASSIUM, TOTAL	UG/L	1540	2780 J	1990	2080
SELENIUM, TOTAL	UG/L	4.30	2.00 UJ	4.00 U	4.00 U
SILVER, TOTAL	UG/L	2.00 U	1.00 UJ	2.00 U	2.00 U
THALLIUM, TOTAL	UG/L	4.00 U	2.00 UJ	4.00 U	4.00 U
VANADIUM, TOTAL	UG/L	1.00 U	1.00 UJ	1.00 U	1.20
ZINC, TOTAL	UG/L	2.70	1.70 UJ	10.4	12.5

TABLE B-2.c.1a
ORR TURKEY CREEK SURFACE WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		07-SW-T1	07-SW-T2	06-SW-T3	06-SW-T3,D
ANALYTES	UNITS	SW	SW	SW	SW
SVOCs					
1,2-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U
1,2,4-TRICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U
1,3-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U
1,4-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U
2-CHLORONAPHTHALENE	UG/L	10 U	10 U	10 U	10 U
2-CHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U
2-METHYL-4,6-DINITROPHENOL	UG/L	25 U	25 U	25 U	25 U
2-METHYLNAPHTHALENE	UG/L	10 U	10 U	10 U	10 U
2-METHYLPHENOL (O-CRESOL)	UG/L	10 U	10 U	10 U	10 U
2-NITROANILINE	UG/L	25 U	25 U	25 U	25 U
2-NITROPHENOL	UG/L	10 U	10 U	10 U	10 U
2,4-DICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U
2,4-DIMETHYLPHENOL	UG/L	10 U	10 U	10 U	10 U
2,4-DINITROPHENOL	UG/L	25 U	25 UJ	25 UJ	25 U
2,4,5-TRICHLOROPHENOL	UG/L	25 U	25 U	25 U	25 U
2,4,6-TRICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U
3-NITROANILINE	UG/L	25 U	25 U	25 U	25 U
3,3'-DICHLOROBENZIDINE	UG/L	10 U	10 U	10 U	10 U
4-BROMOPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U
4-CHLORO-3-METHYLPHENOL	UG/L	10 U	10 U	10 U	10 U
4-CHLOROANILINE	UG/L	10 U	10 U	10 U	10 U
4-CHLOROPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U
4-METHYLPHENOL (P-CRESOL)	UG/L	10 U	10 U	10 U	10 U
4-NITROANILINE	UG/L	25 U	25 U	25 U	25 U
4-NITROPHENOL	UG/L	25 U	25 U	25 U	25 U
ACENAPHTHENE	UG/L	10 U	10 U	10 U	10 U
ACENAPHTHYLENE	UG/L	10 U	10 U	10 U	10 U
ANTHRACENE	UG/L	10 U	10 U	10 U	10 U
BENZO(A)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U
BENZO(A)PYRENE	UG/L	10 U	10 U	10 U	10 U
BENZO(B)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U
BENZO(G,H,I)PERYLENE	UG/L	10 U	10 U	10 U	10 U
BENZO(K)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHOXY)METHANE	UG/L	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHYL) ETHER	UG/L	10 U	10 U	10 U	10 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 U	10 U	10 U	10 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	10 U	10 BU	10 BU	10 BU
BUTYLBENZYLPHTHALATE	UG/L	10 U	0.60 J	10 U	10 U
CARBAZOLE	UG/L	10 U	10 U	10 U	10 U

TABLE B-2.c.1a
ORR TURKEY CREEK SURFACE WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		07-SW-T1	07-SW-T2	06-SW-T3	06-SW-T3,D
ANALYTES	UNITS	SW	SW	SW	SW
SVOCs, cont.					
CHRYSENE	UG/L	10 U	10 U	10 U	10 U
DIBENZOFURAN	UG/L	10 U	10 U	10 U	10 U
DIBENZO(A,H)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U
DIETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U
DIMETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U
DI-N-BUTYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U
DI-N-OCTYL PHTHALATE	UG/L	10 U	10 U	10 UJ	10 U
FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U
FLUORENE	UG/L	10 U	10 U	10 U	10 U
HEXACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U
HEXACHLOROBUTADIENE	UG/L	10 U	10 U	10 U	10 U
HEXACHLOROCYCLOPENTADIENE	UG/L	10 UJ	10 UJ	10 UJ	10 UJ
HEXACHLOROETHANE	UG/L	10 U	10 U	10 UJ	10 U
INDENO(1,2,3-CD)PYRENE	UG/L	10 U	10 U	10 U	10 U
ISOPHORONE	UG/L	10 U	10 U	10 U	10 U
NAPHTHALENE	UG/L	10 U	10 U	10 U	10 U
N-NITROSO-DI-N-PROPYLAMINE	UG/L	10 U	10 UJ	10 UJ	10 UJ
N-NITROSODIPHENYLAMINE	UG/L	10 U	10 U	10 U	10 U
PENTACHLOROPHENOL	UG/L	25 U	25 U	25 U	25 U
PHENANTHRENE	UG/L	10 U	10 U	10 U	10 U
PHENOL	UG/L	10 U	10 U	10 U	10 U
PYRENE	UG/L	10 U	10 U	10 UJ	10 U
VOCs					
1,1-DICHLOROETHANE	UG/L	10 U	10 U	10 U	10 U
1,1-DICHLOROETHENE	UG/L	10 U	10 U	10 U	10 U
1,1,1-TRICHLOROETHANE	UG/L	10 U	10 U	10 U	10 U
1,1,2-TRICHLOROETHANE	UG/L	10 U	10 U	10 U	10 U
1,1,2,2-TETRACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	UG/L	10 U	10 U	10 U	10 U
1,2-DICHLOROETHENE(TOTAL)	UG/L	10 U	10 U	10 U	10 U
1,2-DICHLOROPROPANE	UG/L	10 U	10 U	10 U	10 U
2-BUTANONE (MEK)	UG/L	10 UJ	10 UJ	10 UJ	10 UJ
2-HEXANONE	UG/L	10 U	10 U	10 U	10 U
4-METHYL-2-PENTANONE (MIBK)	UG/L	10 U	10 U	10 U	10 U
ACETONE	UG/L	10 UJ	10 U	10 UJ	10 UJ
BENZENE	UG/L	10 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	UG/L	10 U	10 U	10 U	10 U
BROMOFORM	UG/L	10 U	10 U	10 U	10 U
BROMOMETHANE (METHYL BROMIDE)	UG/L	10 U	10 U	10 U	10 U

TABLE B-2.c.1a
ORR TURKEY CREEK SURFACE WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		07-SW-T1	07-SW-T2	06-SW-T3	06-SW-T3,D
ANALYTES	UNITS	SW	SW	SW	SW
VOCs, cont.					
CARBON DISULFIDE	UG/L	10 UJ	10 U	10 U	10 U
CARBON TETRACHLORIDE	UG/L	10 U	10 U	10 U	10 U
CHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U
CHLOROETHANE	UG/L	10 UJ	10 UJ	10 U	10 U
CHLOROFORM	UG/L	10 U	10 U	10 U	10 U
CHLOROMETHANE (METHYL CHLORIDE	UG/L	10 UJ	10 UJ	10 UJ	10 UJ
CIS-1,3-DICHLOROPROPENE	UG/L	10 U	10 U	10 U	10 U
DIBROMOCHLOROMETHANE	UG/L	10 U	10 U	10 U	10 U
ETHYLBENZENE	UG/L	10 U	10 U	10 U	10 U
METHYLENE CHLORIDE	UG/L	10 BUJ	10 BU	25 BUJ	22 BUJ
STYRENE	UG/L	10 U	10 U	10 U	10 U
TETRACHLOROETHENE	UG/L	10 U	10 U	10 U	10 U
TOLUENE	UG/L	10 U	10 U	10 U	10 U
TRANS-1,3-DICHLOROPROPENE	UG/L	10 U	10 U	10 U	10 U
DICHLOROETHENE	UG/L	10 U	10 U	10 U	10 U
VINYL CHLORIDE	UG/L	10 UJ	10 U	10 U	10 U
XYLENE, TOTAL	UG/L	10 U	10 U	10 U	10 U
WATER QUALITY PARAMETER					
ALKALINITY	MG/L	130	130	120	120
CHEMICAL OXYGEN DEMAND	MG/L	10 U	10 U	10 U	14.8
CHLORIDE	MG/L	4.70	8.40	9.90	10.4
NITROGEN (NO2+NO3)	MG/L	0.10 U	0.10 U	0.10	0.10 U
SODIUM, TOTAL	MG/L	6290	7680 J	9600	10100
SULFATE	MG/L	24.7	34.6	31.6	31.8
TOTAL DISSOLVED SOLIDS	MG/L	190	230	190	190

TABLE B-2.c.1b
ORR TURKEY CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		07-SED-T1	07-SED-T2	06-SED-T3	06-SED-T3,D
ANALYTES	UNITS	Sediment	Sediment	Sediment	Sediment
EXPLOSIVES					
1,3-DINITROBENZENE	UG/KG	250 U	250 U	250 U	250 U
1,3,5-TRINITROBENZENE	UG/KG	250 UJ	250 UR	250 U	250 U
2,4-DINITROTOLUENE	UG/KG	430 U	460 U	130 J	470 U
2,4-DINITROTOLUENE,(2)	UG/KG	250 U	250 U	250 U	250 U
2,4,6-TRINITROTOLUENE (TNT)	UG/KG	250 U	250 UJ	250 U	250 U
2,6-DINITROTOLUENE	UG/KG	430 U	460 U	460 U	470 U
2,6-DINITROTOLUENE,(2)	UG/KG	260 U	260 U	260 U	260 U
HMX	UG/KG	2200 U	2200 U	2200 U	2200 U
M-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U
NITROBENZENE	UG/KG	430 U	460 U	460 U	470 U
NITROBENZENE,(2)	UG/KG	260 U	260 U	260 U	260 U
O-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U
P-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U
RDX	UG/KG	1000 U	1000 U	1000 U	1000 U
TETRYL	UG/KG	650 U	650 U	650 U	650 U
INORGANICS					
ALUMINUM, TOTAL	MG/KG	2700 J	3020 J	3930 J	3600 J
ANTIMONY, TOTAL	MG/KG	0.80 UJ	0.94 UJ	0.83 UJ	0.88 UJ
ARSENIC, TOTAL	MG/KG	5.50 J	6.50	9.10 J	8.30 J
BARIUM, TOTAL	MG/KG	49.5	44.8	61.4	58.3
BERYLLIUM, TOTAL	MG/KG	0.61	0.75	0.79	0.77
CADMIUM, TOTAL	MG/KG	0.27 U	0.31 U	0.62	0.75
CALCIUM, TOTAL	MG/KG	897 J	1400 J	1150 J	1060 J
CHROMIUM, TOTAL	MG/KG	8.50 J	12.2 J	12.7 J	12.3 J
COBALT, TOTAL	MG/KG	7.60	10.3	9.30 J	9.20 J
COPPER, TOTAL	MG/KG	6.50	7.70 J	11.1	12
CYANIDE	MG/KG	0.20 U	0.24 UR	0.21 U	0.22 U
IRON, TOTAL	MG/KG	11900 J	13300 J	18300 J	16600 J
LEAD, TOTAL	MG/KG	10.1 J	9.90 J	11 J	11.2 J
MAGNESIUM, TOTAL	MG/KG	348	398 J	489	458
MANGANESE, TOTAL	MG/KG	300 J	167 J	521 J	433 J
MERCURY, TOTAL	MG/KG	0.13 U	0.16 U	0.14 U	0.15 U
NICKEL, TOTAL	MG/KG	11.1	16.7 J	15.6	15.7
POTASSIUM, TOTAL	MG/KG	305	705 U	562	528
SELENIUM, TOTAL	MG/KG	0.66	0.95	0.74	0.59 U
SILVER, TOTAL	MG/KG	0.27 U	0.31 U	0.28 U	0.29 U
THALLIUM, TOTAL	MG/KG	0.53 U	0.77 U	0.56 U	0.59 U
VANADIUM, TOTAL	MG/KG	11.1	14.4	15.3 J	13.8 J
ZINC, TOTAL	MG/KG	23.9 J	34.7 J	45.7 J	48.6 J

TABLE B-2.c.1b
ORR TURKEY CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
SK ASSESSMENT
AVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		07-SED-T1	07-SED-T2	06-SED-T3	06-SED-T3,D
ANALYTES	UNITS	Sediment	Sediment	Sediment	Sediment
SVOCs					
1,2-DICHLOROBENZENE	UG/KG	430 U	460 U	460 U	470 U
1,2,4-TRICHLOROBENZENE	UG/KG	430 U	460 U	460 U	470 U
1,3-DICHLOROBENZENE	UG/KG	430 U	460 U	460 U	470 U
1,4-DICHLOROBENZENE	UG/KG	430 U	460 U	460 U	470 U
2-CHLORONAPHTHALENE	UG/KG	430 U	460 U	460 U	470 U
2-CHLOROPHENOL	UG/KG	430 U	460 U	460 U	470 U
2-METHYL-4,6-DINITROPHENOL	UG/KG	1000 U	1100 U	1100 U	1100 U
2-METHYLNAPHTHALENE	UG/KG	430 U	460 U	460 U	470 U
2-METHYLPHENOL (O-CRESOL)	UG/KG	430 U	460 U	460 U	470 U
2-NITROANILINE	UG/KG	1000 U	1100 U	1100 U	1100 U
2-NITROPHENOL	UG/KG	430 U	460 U	460 U	470 U
2,4-DICHLOROPHENOL	UG/KG	430 U	460 U	460 U	470 U
2,4-DIMETHYLPHENOL	UG/KG	430 U	460 U	460 U	470 U
2,4-DINITROPHENOL	UG/KG	1000 U	1100 UJ	1100 U	1100 U
2,4,5-TRICHLOROPHENOL	UG/KG	1000 U	1100 U	1100 U	1100 U
4,6-TRICHLOROPHENOL	UG/KG	430 U	460 U	460 U	470 U
-NITROANILINE	UG/KG	1000 U	1100 U	1100 U	1100 U
3,3'-DICHLOROBENZIDINE	UG/KG	430 U	460 U	460 U	470 U
4-BROMOPHENYL PHENYL ETHER	UG/KG	430 U	460 U	460 U	470 U
4-CHLORO-3-METHYLPHENOL	UG/KG	430 U	460 U	460 U	470 U
4-CHLOROANILINE	UG/KG	430 U	460 U	460 U	470 U
4-CHLOROPHENYL PHENYL ETHER	UG/KG	430 U	460 U	460 U	470 U
4-METHYLPHENOL (P-CRESOL)	UG/KG	430 U	460 U	460 U	470 U
4-NITROANILINE	UG/KG	1000 U	1100 U	1100 U	1100 U
4-NITROPHENOL	UG/KG	1000 U	1100 U	1100 U	1100 U
ACENAPHTHENE	UG/KG	430 U	460 U	460 U	470 U
ACENAPHTHYLENE	UG/KG	430 U	460 U	460 U	470 U
ANTHRACENE	UG/KG	430 U	460 U	460 U	470 U
BENZO(A)ANTHRACENE	UG/KG	430 U	460 U	460 U	470 U
BENZO(A)PYRENE	UG/KG	29 J	460 U	460 U	470 U
BENZO(B)FLUORANTHENE	UG/KG	430 U	460 U	460 U	44 J
BENZO(G,H,I)PERYLENE	UG/KG	430 U	460 U	460 U	470 U
BENZO(K)FLUORANTHENE	UG/KG	430 U	460 U	460 U	470 U
BIS(2-CHLOROETHOXY)METHANE	UG/KG	430 U	460 U	460 U	470 U
BIS(2-CHLOROETHYL) ETHER	UG/KG	430 U	460 U	460 U	470 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	430 U	460 U	460 U	470 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	430 BU	460 BU	460 BU	470 BU
BUTYLBENZYLPHTHALATE	UG/KG	430 U	460 U	460 U	470 U
RBAZOLE	UG/KG	430 U	460 U	460 U	470 U

TABLE B-2.c.1b
ORR TURKEY CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		07-SED-T1	07-SED-T2	06-SED-T3	06-SED-T3,D
ANALYTES	UNITS	Sediment	Sediment	Sediment	Sediment
SVOCs, cont.					
CHRYSENE	UG/KG	430 U	460 U	460 U	30 J
DIBENZOFURAN	UG/KG	430 U	460 U	460 U	470 U
DIBENZO(A,H)ANTHRACENE	UG/KG	430 U	460 U	460 U	470 U
DIETHYL PHTHALATE	UG/KG	430 U	460 U	460 U	470 U
DIMETHYL PHTHALATE	UG/KG	430 U	460 U	460 U	470 U
DI-N-BUTYL PHTHALATE	UG/KG	41 J	460 U	170 J	26 J
DI-N-OCTYL PHTHALATE	UG/KG	430 U	460 U	460 U	470 U
FLUORANTHENE	UG/KG	430 U	460 U	31 J	36 J
FLUORENE	UG/KG	430 U	460 U	460 U	470 U
HEXACHLOROBENZENE	UG/KG	430 U	460 U	460 U	470 U
HEXACHLOROBUTADIENE	UG/KG	430 U	460 U	460 U	470 U
HEXACHLOROCYCLOPENTADIENE	UG/KG	430 UJ	460 UJ	460 UJ	470 UJ
HEXACHLOROETHANE	UG/KG	430 U	460 U	460 U	470 U
INDENO(1,2,3-CD)PYRENE	UG/KG	430 U	460 U	460 U	470 U
ISOPHORONE	UG/KG	430 U	460 U	460 U	470 U
NAPHTHALENE	UG/KG	430 U	460 U	460 U	470 U
N-NITROSO-DI-N-PROPYLAMINE	UG/KG	430 U	460 UJ	460 U	470 U
N-NITROSODIPHENYLAMINE	UG/KG	430 U	460 U	23 J	470 U
PENTACHLOROPHENOL	UG/KG	1000 U	1100 U	1100 U	1100 U
PHENANTHRENE	UG/KG	430 U	460 U	460 U	470 U
PHENOL	UG/KG	430 U	460 U	460 U	470 U
PYRENE	UG/KG	430 U	460 U	29 J	38 J
VOCs					
1,1-DICHLOROETHANE	UG/KG	13 U	14 U	14 U	14 U
1,1-DICHLOROETHENE	UG/KG	13 U	14 U	14 U	14 U
1,1,1-TRICHLOROETHANE	UG/KG	13 U	14 U	14 U	14 U
1,1,2-TRICHLOROETHANE	UG/KG	13 U	14 U	14 U	14 U
1,1,2,2-TETRACHLOROETHANE	UG/KG	13 U	14 U	14 U	14 U
1,2-DICHLOROETHANE	UG/KG	13 U	14 U	14 U	14 U
1,2-DICHLOROETHENE(TOTAL)	UG/KG	13 U	14 U	14 U	14 U
1,2-DICHLOROPROPANE	UG/KG	13 U	14 U	14 U	14 U
2-BUTANONE (MEK)	UG/KG	8.00 J	6.00 J	5.00 J	9.00 J
2-HEXANONE	UG/KG	13 UJ	14 U	14 U	14 U
4-METHYL-2-PENTANONE (MIBK)	UG/KG	13 UJ	14 U	14 U	14 U
ACETONE	UG/KG	44 BU	25	26 BU	38 BU
BENZENE	UG/KG	13 U	14 U	14 U	14 U
BROMODICHLOROMETHANE	UG/KG	13 U	14 U	14 U	14 U
BROMOFORM	UG/KG	13 U	14 U	14 U	14 U
BROMOMETHANE (METHYL BROMIDE)	UG/KG	13 U	14 U	14 U	14 U

TABLE B-2.c.1b
ORR TURKEY CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
ISK ASSESSMENT
AVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		07-SED-T1	07-SED-T2	06-SED-T3	06-SED-T3,D
ANALYTES	UNITS	Sediment	Sediment	Sediment	Sediment
VOCs, cont.					
CARBON DISULFIDE	UG/KG	13 U	14 U	14 U	14 U
CARBON TETRACHLORIDE	UG/KG	13 U	14 U	14 U	14 U
CHLOROBENZENE	UG/KG	13 U	14 U	14 U	14 U
CHLOROETHANE	UG/KG	13 U	14 U	14 UJ	14 UJ
CHLOROFORM	UG/KG	13 U	14 U	14 U	14 U
CHLOROMETHANE (METHYL CHLORIDE)	UG/KG	13 U	14 U	14 U	14 U
CIS-1,3-DICHLOROPROPENE	UG/KG	13 U	14 U	14 U	14 U
DIBROMOCHLOROMETHANE	UG/KG	13 U	14 U	14 U	14 U
ETHYLBENZENE	UG/KG	13 U	14 U	14 U	14 U
METHYLENE CHLORIDE	UG/KG	13 BU	14 U	43 BU	44 BU
STYRENE	UG/KG	13 U	14 U	14 U	14 U
TETRACHLOROETHENE	UG/KG	13 U	14 U	14 U	14 U
TOLUENE	UG/KG	13 U	14 U	14 U	14 U
TRANS-1,3-DICHLOROPROPENE	UG/KG	13 U	14 U	14 U	14 U
TRICHLOROETHENE	UG/KG	13 U	14 U	14 U	14 U
INYL CHLORIDE	UG/KG	13 U	14 U	14 U	14 U
YLENE, TOTAL	UG/KG	13 U	14 U	14 U	14 U
WATER QUALITY PARAMETER					
NITROGEN (NO2+NO3)	MG/KG	1.30 U	1.40 U	1.39 U	1.43 U
SODIUM, TOTAL	MG/KG	38 U	63.5	39.5 U	63.9

TABLE B-2.d.1
ORR GROUND WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME ANALYTES	UNITS	06C12 BCH CRK	06C12,D BCH CRK	06C16 BCH CRK	06C18 BCH CRK	06C19P2 BCH CRK	06-17 SURF	06-22 SURF	06C16P2 SURF	06C18P2 SURF	06C19 SURF
EXPLOSIVES											
1,3-DINITROBENZENE	UG/L	4.00 U	4.00 U	4.00 UJ	4.00 U	4.00 U	4.00 UJ	4.00 UJ	4.00 UJ	4.00 U	4.00 U
1,3,5-TRINITROBENZENE	UG/L	7.30 U	7.30 U	7.30 UJ	7.30 U	7.30 U	7.30 UJ	7.30 UJ	7.30 UJ	7.30 U	7.30 U
2,4-DINITROTOLUENE	UG/L	5.70 U	5.70 U	5.70 UJ	5.70 U	5.70 U	5.70 UJ	5.70 UJ	5.70 UJ	5.70 U	5.70 U
2,4-DINITROTOLUENE(OLM01.8)	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
2,4,6-TRINITROTOLUENE (TNT)	UG/L	6.40 U	6.40 U	6.40 UJ	6.40 U	6.40 U	6.40 UJ	111 J	6.40 UJ	6.40 U	6.40 U
2,6-DINITROTOLUENE	UG/L	9.40 U	9.40 U	9.40 UJ	9.40 U	9.40 U	9.40 UJ	9.40 UJ	9.40 UJ	9.40 U	9.40 U
2,6-DINITROTOLUENE(OLM01.8)	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
HMX	UG/L	13 U	13 U	13 UJ	13 U	13 U	13 UJ	13 UJ	13 UJ	13 U	13 U
M-NITROTOLUENE	UG/L	7.90 U	7.90 U	7.90 UJ	7.90 U	7.90 U	7.90 UJ	7.90 UJ	7.90 UJ	7.90 U	7.90 U
NITROBENZENE	UG/L	7.00 U	7.00 U	7.00 UJ	7.00 U	7.00 U	7.00 UJ	7.00 UJ	7.00 UJ	7.00 U	7.00 U
NITROBENZENE(OLM01.8)	UG/L	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
O-NITROTOLUENE	UG/L	12 U	12 U	12 UJ	12 U	12 U	12 UJ	12 UJ	12 UJ	12 U	12 U
P-NITROTOLUENE	UG/L	8.00 U	8.00 U	8.00 UJ	8.00 U	8.00 U	8.00 UJ	8.00 UJ	8.00 UJ	8.00 U	8.00 U
RDX	UG/L	14 U	14 U	14 UJ	14 U	14 U	14 UJ	14 UJ	14 UJ	14 U	14 U
TETRYL	UG/L	10 U	10 U	10 UJ	10 UJ	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
INORGANICS											
ALUMINUM, TOTAL	UG/L	28.7 UJ	14.9 UJ	14.4 UJ	55.9	8630 J	329 J	85.1 UJ	219 J	500	77.8
ANTIMONY, TOTAL	UG/L	3.00 UJ	3.00 UJ	3.00 UJ	3.00 U	3.40	3.00 UJ	3.00 UJ	3.00 UJ	3.00 U	3.00 U
ARSENIC, TOTAL	UG/L	5.20 J	2.00 J	2.00 UJ	2.00 U	27.7	2.00 UJ	2.10 J	2.00 UJ	19.6	2.00 U
BARIUM, TOTAL	UG/L	54.1 J	51.4 J	116 J	99.5	100	75.2 J	24.1 J	26.6 J	113	38.3
BERYLLIUM, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.60	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 U
CADMIUM, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 U	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 U
CALCIUM, TOTAL	UG/L	86700 J	87000 J	8600 J	42300 J	35800 J	8550 J	54500 J	92100 J	40700 J	40200 J
CHROMIUM, TOTAL	UG/L	1.90 UJ	1.40 UJ	1.00 UJ	1.00 U	27.5	14.9 J	2.20 UJ	5.30 UJ	4.90	1.00
COBALT, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	20	1.70 J	1.00 UJ	1.00 UJ	1.00 U	2.10
COPPER, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	26.9	5.20 UJ	1.10 UJ	1.00 UJ	1.00 U	1.00 U
CYANIDE	UG/L	3.00 UJ	3.00 UJ	5.80 J	3.00 U	3.00 U	3.00 UJ	3.00 UJ	3.00 UJ	3.00 U	3.00 U
IRON, TOTAL	UG/L	584 J	576 J	48 J	3940 J	53400	775 J	572 J	499 J	33400 J	1640 J
LEAD, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	27.8	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 U
MAGNESIUM, TOTAL	UG/L	13100 J	13000 J	4360 J	7960 J	8120	5300 J	11500 J	50500 J	9260 J	7100 J
MANGANESE, TOTAL	UG/L	327 J	325 J	2.70 UJ	135	391	244 J	64.4 J	77.5 J	540	215
MERCURY, TOTAL	UG/L	0.20 UJ	0.20 UJ	0.20 UJ	0.23	0.2 U	0.20 UJ	0.20 UJ	0.20 UJ	0.2 U	0.2 U
NICKEL, TOTAL	UG/L	1.50 UJ	1.00 UJ	1.00 UJ	1.00 U	36.5	27.7 J	1.30 UJ	2.90 UJ	1.90 U	3.60 U
POTASSIUM, TOTAL	UG/L	2730 UJ	2700 UJ	2180 J	2330 U	3840	4040 J	3670 J	5880 J	1980	1530
SELENIUM, TOTAL	UG/L	2.60 J	2.00 UJ	2.00 UJ	2.00 U	2.50	2.00 UJ	2.00 UJ	2.00 UJ	2.30	2.00 U
SILVER, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	1.00 U	1.00 UJ	1.00 J	1.00 UJ	1.20	1.20
THALLIUM, TOTAL	UG/L	3.90 UJ	2.10 UJ	2.00 UJ	2.00 U	2.40 U	2.00 UJ	2.30 J	2.70 J	2.90 U	2.00 U
VANADIUM, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 U	36.9	1.00 J	1.10 J	1.10 J	2.10	1.00 U
ZINC, TOTAL	UG/L	3.30 UJ	2.30 UJ	1.70 UJ	2.20 U	112 J	24.9 J	3.90 UJ	2.00 UJ	6.10 J	4.70 U

TABLE B-2.d.1
ORR GROUN[illegible]R SAMPLE RESULTS
1995 SOUTH[illegible]AB
RISK ASSESSME[illegible]
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06C12	06C12,D	06C16	06C18	06C19P2	06-17	06-22	06C16P2	06C18P2	06C19
ANALYTES	UNITS	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF	SURF
SVOCs											
1,2-DICHLOROBENZENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
1,2,4-TRICHLOROBENZENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
1,3-DICHLOROBENZENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
1,4-DICHLOROBENZENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
2-CHLORONAPHTHALENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
2-CHLOROPHENOL	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 U	10 UJ	10 U	10 U
2-METHYL-4,6-DINITROPHENOL	UG/L	25 U	25 U	25 UJ	25 U	25 U	25 UJ	25 U	25 UJ	25 U	25 U
2-METHYLNAPHTHALENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
2-METHYLPHENOL (O-CRESOL)	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 U	10 UJ	10 U	10 U
2-NITROANILINE	UG/L	25 U	25 U	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ
2-NITROPHENOL	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 U	10 UJ	10 U	10 U
2,4-DICHLOROPHENOL	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 U	10 UJ	10 U	10 U
2,4-DIMETHYLPHENOL	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 U	10 UJ	10 U	10 U
2,4-DINITROPHENOL	UG/L	25 U	25 U	25 UJ	25 U	25 U	25 UJ	25 UJ	25 UJ	25 U	25 U
2,4,5-TRICHLOROPHENOL	UG/L	25 U	25 U	25 UJ	25 U	25 U	25 UJ	25 U	25 UJ	25 U	25 U
2,4,6-TRICHLOROPHENOL	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 U	10 UJ	10 U	10 U
3-NITROANILINE	UG/L	25 U	25 U	25 UJ	25 U	25 U	25 U	25 U	25 UJ	25 U	25 U
3,3'-DICHLOROBENZIDINE	UG/L	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ
4-BROMOPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
4-CHLORO-3-METHYLPHENOL	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 U	10 UJ	10 U	10 U
4-CHLOROANILINE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
4-CHLOROPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
4-METHYLPHENOL (P-CRESOL)	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 U	10 UJ	10 U	10 U
4-NITROANILINE	UG/L	25 UJ	25 UJ	25 UJ	25 U	25 U	25 U	25 U	25 UJ	25 U	25 U
4-NITROPHENOL	UG/L	25 U	25 U	25 UJ	25 U	25 U	25 UJ	25 U	25 UJ	25 U	25 U
ACENAPHTHENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
ACENAPHTHYLENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
ANTHRACENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
BENZO(A)ANTHRACENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
BENZO(A)PYRENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
BENZO(B)FLUORANTHENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
BENZO(G,H,I)PERYLENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
BENZO(K)FLUORANTHENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
BIS(2-CHLOROETHOXY)METHANE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
BIS(2-CHLOROETHYL) ETHER	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	10 BU	10 BU	10 UJ	10 U	1.00 J	10 U	10 U	10 BUJ	10 U	10 U
BUTYLBENZYLPHTHALATE	UG/L	10 U	10 U	1.00 J	10 U	10 U	10 U	10 U	10 UJ	10 U	1.00 J
CARBAZOLE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U

TABLE B-2.d.1
ORR GROUND WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME ANALYTES	UNITS	06C12 BCH CRK	06C12,D BCH CRK	06C16 BCH CRK	06C18 BCH CRK	06C19P2 BCH CRK	06-17 SURF	06-22 SURF	06C16P2 SURF	06C18P2 SURF	06C19 SURF
SVOCs, cont.											
CHRYSENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
DIBENZOFURAN	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
DIBENZO(A,H)ANTHRACENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
DIETHYL PHTHALATE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
DIMETHYL PHTHALATE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
DI-N-BUTYL PHTHALATE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
DI-N-OCTYL PHTHALATE	UG/L	10 UJ	10 UJ	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
FLUORANTHENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
FLUORENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
HEXACHLOROBENZENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
HEXACHLOROBUTADIENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
HEXACHLOROCYCLOPENTADIENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
HEXACHLOROETHANE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
INDENO(1,2,3-CD)PYRENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
ISOPHORONE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
NAPHTHALENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
N-NITROSO-DI-N-PROPYLAMINE	UG/L	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ
N-NITROSODIPHENYLAMINE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
PENTACHLOROPHENOL	UG/L	25 U	25 U	25 UJ	25 U	25 U	25 UJ	25 U	25 UJ	25 U	25 U
PHENANTHRENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
PHENOL	UG/L	10 U	10 U	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 UJ	10 UJ	10 UJ
PYRENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U
VOCs											
1,1-DICHLOROETHANE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
1,1-DICHLOROETHENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
1,1,1-TRICHLOROETHANE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
1,1,2-TRICHLOROETHANE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
1,1,2,2-TETRACHLOROETHANE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
1,2-DICHLOROETHANE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
1,2-DICHLOROETHENE(TOTAL)	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
1,2-DICHLOROPROPANE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
2-BUTANONE (MEK)	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
2-HEXANONE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
4-METHYL-2-PENTANONE (MIBK)	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
ACETONE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
BENZENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
BROMODICHLOROMETHANE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
BROMOFORM	UG/L	10 UJ	10 UJ	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
BROMOMETHANE (METHYL BROMIDE)	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U

TABLE B-2.d.1
ORR GROUND[illegible]R SAMPLE RESULTS
1995 SOUTH[illegible]AB
RISK ASSESSM[illegible]
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06C12	06C12,D	06C16	06C18	06C19P2	06-17	06-22	06C16P2	06C18P2	06C19
ANALYTES	UNITS	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	SURF	SURF	SURF	SURF	SURF
VOCs, cont.											
CARBON DISULFIDE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
CARBON TETRACHLORIDE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
CHLOROBENZENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
CHLOROETHANE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
CHLOROFORM	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
CHLOROMETHANE (METHYL CHLORIDE)	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
CIS-1,3-DICHLOROPROPENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
DIBROMOCHLOROMETHANE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
ETHYLBENZENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
METHYLENE CHLORIDE	UG/L	22 BU	27 BU	11 BUJ	12 BU	36 BUJ	10 BUJ	16 BUJ	14 BUJ	10 BUJ	11 BUJ
STYRENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
TETRACHLOROETHENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
TOLUENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
TRANS-1,3-DICHLOROPROPENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
TRICHLOROETHENE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
VINYL CHLORIDE	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
XYLENE, TOTAL	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U
WATER QUALITY PARAMETER											
ALKALINITY	MG/L	240	272	353	183	137 J	20 U	160	357	122	154
CHEMICAL OXYGEN DEMAND	MG/L	10 U	10 U	10 U	10 U	56.2	12.6	10 U	10 U	23.5	10 U
CHLORIDE	MG/L	2.10	1.90	1.60	2.50	3.20	1.70	1.50	2.30	23.8	3.70
NITROGEN (NO2+NO3)	MG/L	0.10 U	0.10 U	0.10 U	0.1 U	0.1 U	1.40	2.60	0.10 U	0.1 U	0.1 U
SODIUM, TOTAL	MG/L	6590 J	6590 J	177000 J	38000 J	27100	2420 J	3000 J	30400 J	21000	21900
SULFATE	MG/L	42.1	38.5	52.5	29.9	31.5	27.2	2.60	150	40.1	29.4
TOTAL DISSOLVED SOLIDS	MG/L	300	300	450	1590 J	3790 J	140 U	230	680	1820 J	1810 J
CYCLOHEXANE	MG/L										

TABLE B-3.a.1
DR BACKGROUND/ARMY/NAVY AREAS SURFACE SOIL SAMPLES
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06SS-A01	06SS-A01,D	06SS-A02	06SS-A03	06SS-A07	06SS-A08	06SS-A09	06SS-A10
SAMPLE TYPE	UNITS	BKGRD	BKGRD	BKGRD	BKGRD	ARMY	ARMY	ARMY	ARMY
EXPLOSIVES									
1,3,5-TRINITROBENZENE	UG/KG	250 UR	250 UR	250 UR	250 UR	250 UJ	250 UJ	250 UJ	250 UJ
1,3-DINITROBENZENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,4,6-TRINITROTOLUENE (TNT)	UG/KG	250 UJ	250 UJ	250 UJ	250 UJ	3030	1660	2550	1890
2,4-DINITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,4-DINITROTOLUENE(2)	UG/KG	390 U	410 U	380 U	410 U	190 J	67 J	76 J	88 J
2,6-DINITROTOLUENE	UG/KG	260 U	260 U	260 U	260 U	260 U	260 U	260 U	260 U
2,6-DINITROTOLUENE(2)	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
HMX	UG/KG	2200 U	2200 U	2200 U	2200 U	2200 U	2200 U	2200 U	2200 U
M-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
NITROBENZENE	UG/KG	260 U	260 U	260 U	260 U	260 U	260 U	260 U	260 U
NITROBENZENE(2)	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
O-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
P-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
RDX	UG/KG	1000 U	1000 U	1000 U	1000 U	4760	2690	2120	2980
TETRYL	UG/KG	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U
INORGANICS									
ALUMINUM, TOTAL	MG/KG	7290 J	6660 J	4180 J	5810 J	3840 J	4050 J	4830 J	4330 J
ANTIMONY, TOTAL	MG/KG	0.87 J	1.20 J	0.69 UJ	0.76 UJ	0.75 J	0.74 J	0.83 J	0.65 J
ARSENIC, TOTAL	MG/KG	8.40 J	9.80 J	4.70 J	6.20 J	11.3	11.2	17.5	10.6
BARIUM, TOTAL	MG/KG	102 J	105 J	246 J	119 J	79.7	43.6	50.4	49.4
BERYLLIUM, TOTAL	MG/KG	0.70	0.80	0.59	0.83	0.86	0.70	0.86	0.76
CADMIUM, TOTAL	MG/KG	0.66	0.30	0.23 U	0.66	3.70	3.80	2.40	3.40
CALCIUM, TOTAL	MG/KG	10800 J	8110 J	1010 J	1800 J	730 J	572 J	710 J	634 J
CHROMIUM, TOTAL	MG/KG	11.2	14.4	6.70	6.80 J	11	10.7	14.7	11.9
COBALT, TOTAL	MG/KG	13.1	15.3	10.9	11.6	8.50	9.10	9.60	8.90
COPPER, TOTAL	MG/KG	31 J	25.3 J	13 J	27.6 J	125	126	115	163
CYANIDE	MG/KG	0.23 J	0.18 UR	0.17 UR	0.19 UR	0.85	0.49	0.43	1.20
IRON, TOTAL	MG/KG	16800 J	26200 J	8700 J	8870 J	24400 J	21100 J	27300 J	24100 J
LEAD, TOTAL	MG/KG	26.2 J	25.7 J	18.6 J	22.8 J	42.7 J	33.6 J	36.5 J	43.8 J
MAGNESIUM, TOTAL	MG/KG	1680	1430	582	846 J	903	1120	1010	998
MANGANESE, TOTAL	MG/KG	798 J	888 J	560 J	803 J	316	307	309	315
MERCURY, TOTAL	MG/KG	0.12 U	0.12 U	0.12 U	0.13 U	0.11 U	0.10 U	0.11 U	0.10 U
NICKEL, TOTAL	MG/KG	13.1	15.2	7.20	9.40 J	20.5	22.3	20.4	21.6
POTASSIUM, TOTAL	MG/KG	1450 J	1160 J	629 U	1050 U	810	1100	1180	1050
SELENIUM, TOTAL	MG/KG	0.49 U	0.49 U	0.46 U	1.00	0.60 U	0.41 U	0.54 U	0.49 U
SILVER, TOTAL	MG/KG	0.32	0.26	0.23 U	0.25 U	0.49	0.69	0.59	0.67
SODIUM, TOTAL	MG/KG	81.7	53.5	32.8 U	53.6	34.9	61.7	50.8	46.3
THALLIUM, TOTAL	MG/KG	0.51 U	0.85 U	0.46 U	0.50 U	1.50 U	0.60 U	0.61 U	0.41 U
VANADIUM, TOTAL	MG/KG	20.1	23.4	11.6	13	12.7	12.2	16.3	14.2

TABLE B[illegible] 1
DR BAC[illegible] ARMY/NAVY AREAS SURFACE SOIL SAMPLES
1995 SO[illegible] LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06SS-A01	06SS-A01,D	06SS-A02	06SS-A03	06SS-A07	06SS-A08	06SS-A09	06SS-A10
SAMPLE TYPE	UNITS	BKGRD	BKGRD	BKGRD	BKGRD	ARMY	ARMY	ARMY	ARMY
INORGANCIS, cont.									
ZINC, TOTAL	MG/KG	57.2 J	53 J	52.3 J	42.2 J	137	127	105	118
SVOCs									
1,2,4-TRICHLOROBENZENE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
1,2-DICHLOROBENZENE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
1,3-DICHLOROBENZENE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
1,4-DICHLOROBENZENE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
2,4,5-TRICHLOROPHENOL	UG/KG	950 U	990 U	920 U	990 U	850 U	830 U	840 U	830 U
2,4,6-TRICHLOROPHENOL	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
2,4-DICHLOROPHENOL	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
2,4-DIMETHYLPHENOL	UG/KG	390 U	410 U	380 U	410 U	42 J	340 U	350 U	340 U
2,4-DINITROPHENOL	UG/KG	950 UJ	990 UJ	920 UJ	990 UJ	850 U	830 U	840 U	830 U
2-CHLORONAPHTHALENE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
2-CHLOROPHENOL	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
2-METHYL-4,6-DINITROPHENOL	UG/KG	950 U	990 U	920 U	990 U	850 U	830 U	840 U	830 U
2-METHYLNAPHTHALENE	UG/KG	390 U	410 U	380 U	410 U	83 J	23 J	37 J	37 J
2-METHYLPHENOL (O-CRESOL)	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
2-NITROANILINE	UG/KG	950 U	990 U	920 U	990 U	850 U	830 U	840 U	830 U
2-NITROPHENOL	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
3,3'-DICHLOROBENZIDINE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
3-NITROANILINE	UG/KG	950 U	990 U	920 U	990 U	850 U	830 U	840 U	830 U
4-BROMOPHENYL PHENYL ETHER	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
4-CHLORO-3-METHYLPHENOL	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
4-CHLOROANILINE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
4-CHLOROPHENYL PHENYL ETHER	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
4-METHYLPHENOL (P-CRESOL)	UG/KG	390 U	410 U	380 U	410 U	36 J	340 U	350 U	340 U
4-NITROANILINE	UG/KG	950 U	990 U	920 U	990 U	850 U	830 U	840 U	830 U
4-NITROPHENOL	UG/KG	950 U	990 U	920 U	990 U	850 U	830 U	840 U	830 U
ACENAPHTHENE	UG/KG	390 U	410 U	380 U	410 U	23 J	340 U	350 U	340 U
ACENAPHTHYLENE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
ANTHRACENE	UG/KG	390 U	410 U	380 U	410 U	21 J	340 U	350 U	18 J
BENZO(A)ANTHRACENE	UG/KG	390 U	410 U	380 U	410 U	38 J	27 J	28 J	31 J
BENZO(A)PYRENE	UG/KG	390 U	410 U	380 U	410 U	42 J	23 J	32 J	28 J
BENZO(B)FLUORANTHENE	UG/KG	390 U	27 J	380 U	410 U	49 J	22 J	20 J	29 J
BENZO(G,H,I)PERYLENE	UG/KG	390 U	410 U	380 U	410 U	70 J	36 J	37 J	43 J
BENZO(K)FLUORANTHENE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
BIS(2-CHLOROETHOXY)METHANE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
BIS(2-CHLOROETHYL) ETHER	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	390 BU	410 BU	380 BU	410 BU	350 BU	340 BU	350 BU	340 BU

TABLE B-3.a.1
DR BACKGROUND/ARMY/NAVY AREAS SURFACE SOIL SAMPLES
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06SS-A01	06SS-A01,D	06SS-A02	06SS-A03	06SS-A07	06SS-A08	06SS-A09	06SS-A10
SAMPLE TYPE	UNITS	BKGRD	BKGRD	BKGRD	BKGRD	ARMY	ARMY	ARMY	ARMY
SVOCs, cont.									
BUTYLBENZYLPHTHALATE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	26 J	340 U
CARBAZOLE	UG/KG	390 U	410 U	380 U	410 U	20 J	18 J	350 U	23 J
CHRYSENE	UG/KG	390 U	23 J	380 U	410 U	62 J	29 J	42 J	36 J
DI-N-BUTYL PHTHALATE	UG/KG	30 J	24 J	380 U	21 J	140 J	28 J	46 J	53 J
DI-N-OCTYL PHTHALATE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
DIBENZO(A,H)ANTHRACENE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
DIBENZOFURAN	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
DIETHYL PHTHALATE	UG/KG	390 U	410 U	380 U	410 U	32 J	36 J	24 J	40 J
DIMETHYL PHTHALATE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
FLUORANTHENE	UG/KG	20 J	28 J	380 U	410 U	88 J	51 J	79 J	79 J
FLUORENE	UG/KG	390 U	410 U	380 U	410 U	25 J	340 U	18 J	23 J
HEXACHLOROBENZENE	UG/KG	390 U	410 U	380 U	410 U	46 J	25 J	22 J	340 U
HEXACHLOROBUTADIENE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
HEXACHLOROCYCLOPENTADIENE	UG/KG	390 UJ	410 UJ	380 UJ	410 UJ	350 UJ	340 UJ	350 UJ	340 UJ
HEXACHLOROETHANE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
INDENO(1,2,3-CD)PYRENE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
ISOPHORONE	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
N-NITROSO-DI-N-PROPYLAMINE	UG/KG	390 UJ	410 UJ	380 UJ	410 UJ	350 U	340 U	350 U	340 U
N-NITROSODIPHENYLAMINE	UG/KG	390 U	410 U	380 U	410 U	350 U	110 J	54 J	55 J
NAPHTHALENE	UG/KG	390 U	410 U	380 U	410 U	110 J	31 J	65 J	62 J
PENTACHLOROPHENOL	UG/KG	950 U	990 U	920 U	990 U	19 J	830 U	840 U	23 J
PHENANTHRENE	UG/KG	390 U	410 U	380 U	410 U	190 J	96 J	110 J	120 J
PHENOL	UG/KG	390 U	410 U	380 U	410 U	350 U	340 U	350 U	340 U
PYRENE	UG/KG	20 J	21 J	380 U	410 U	160 J	98 J	110 J	110 J

TABLE B-3-a.1
DR BACK[illegible]D/ARMY/NAVY AREAS SURFACE SOIL SAMPLES
1995 SO[illegible]T LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME SAMPLE TYPE	UNITS	06SS-A10,D ARMY	06SS-A11 ARMY	06SS-A12 ARMY	06SS-A13 ARMY	06SS-A14 ARMY	06SS-A04 NAVY	06SS-A05 NAVY	06SS-A06 NAVY
EXPLOSIVES									
1,3,5-TRINITROBENZENE	UG/KG	250 UJ	250 UJ	250 UJ	250 UJ	250 UJ	250 UR	250 UR	250 UR
1,3-DINITROBENZENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
2,4,6-TRINITROTOLUENE (TNT)	UG/KG	1720	1100	2080	602	925	456 J	250 UJ	250 UJ
2,4-DINITROTOLUENE	UG/KG	250 U	250 U	250 U	192 J	270	250 U	250 U	250 U
2,4-DINITROTOLUENE(2)	UG/KG	150 J	370 U	140 J	60 J	100 J	35 J	360 U	340 U
2,6-DINITROTOLUENE	UG/KG	260 U	260 U	260 U	260 U	260 U	260 U	260 U	260 U
2,6-DINITROTOLUENE(2)	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
HMX	UG/KG	2200 U	2200 U	2200 U	2200 U	2200 U	2200 U	2200 U	2200 U
M-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
NITROBENZENE	UG/KG	260 U	260 U	260 U	260 U	260 U	260 U	260 U	260 U
NITROBENZENE(2)	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
O-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
P-NITROTOLUENE	UG/KG	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
RDX	UG/KG	3000	1960	3900	1780	2720	732 J	1000 U	1000 U
TETRYL	UG/KG	650 U	650 U	650 U	650 U	650 U	650 U	650 U	650 U
INORGANICS									
ALUMINUM, TOTAL	MG/KG	3680 J	5110 J	4250 J	5050 J	1770 J	5010 J	6410 J	6540 J
ANTIMONY, TOTAL	MG/KG	0.90 J	0.68 UJ	0.88 J	0.72 J	0.62 UJ	1.30 J	1.40 J	0.92 J
ARSENIC, TOTAL	MG/KG	10.1	7.00	11.7	10.2	5.10	11.3 J	11.8 J	9.00 J
BARIUM, TOTAL	MG/KG	47.9	70.3	48.8	42.6	22.4	314 J	661 J	169 J
BERYLLIUM, TOTAL	MG/KG	0.74	0.93	0.74	0.55	0.33	0.69	1.10	0.64
CADMIUM, TOTAL	MG/KG	3.10	1.10	3.50	1.60	1.30	2.60	1.20	0.21 U
CALCIUM, TOTAL	MG/KG	560 J	905 J	722 J	511 J	430 J	5520 J	22100 J	773 J
CHROMIUM, TOTAL	MG/KG	10.5	13.3	12.4	10.9	4.70	15	17.4	14.5
COBALT, TOTAL	MG/KG	7.90	5.90	9.20	6.40	4.00	10.1	9.60	8.40
COPPER, TOTAL	MG/KG	129	58.5	144	84.1	59.1	109 J	71.2 J	16.3 J
CYANIDE	MG/KG	1.20	0.18	1.00	0.55	0.70	0.16 UR	0.16 UR	0.16 UR
IRON, TOTAL	MG/KG	21800 J	14600 J	26500 J	20500 J	10700 J	24400 J	28600 J	20800 J
LEAD, TOTAL	MG/KG	43.3 J	23.5 J	53 J	30.2 J	19.8 J	40.2 J	27.5 J	16.3 J
MAGNESIUM, TOTAL	MG/KG	853	1800	1080	857	423	914	1620	1150
MANGANESE, TOTAL	MG/KG	281	156	349	237	151	493 J	252 J	407 J
MERCURY, TOTAL	MG/KG	0.10 U	0.11 U	0.10 U	0.10 U	0.10 U	0.11 U	0.11 U	0.10 U
NICKEL, TOTAL	MG/KG	19.4	27.1	22.1	27.1	8.40	20.4	22	10.6
POTASSIUM, TOTAL	MG/KG	903	1090	918	616	473	1270 J	1170 J	623 U
SELENIUM, TOTAL	MG/KG	0.45 U	0.45 U	0.49	0.63	0.41 U	0.43 U	0.69	0.42 U
SILVER, TOTAL	MG/KG	0.52	0.23 U	0.43	0.21 U	0.21 U	0.58	0.22 U	0.21 U
SODIUM, TOTAL	MG/KG	51.6	151	50.8	34.9	48	30.5 U	53	64.9
THALLIUM, TOTAL	MG/KG	0.56 U	0.45 U	0.54 U	0.42 U	0.41 U	1.20 U	1.00 U	0.49 U
VANADIUM, TOTAL	MG/KG	12.7	10.8	15.4	18.2	6.00	17	20.1	22.8

TABLE B-3.a.1
DR BACKGROUND/ARMY/NAVY AREAS SURFACE SOIL SAMPLES
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06SS-A10,D	06SS-A11	06SS-A12	06SS-A13	06SS-A14	06SS-A04	06SS-A05	06SS-A06
SAMPLE TYPE	UNITS	ARMY	ARMY	ARMY	ARMY	ARMY	NAVY	NAVY	NAVY
INORGANICS, cont.									
ZINC, TOTAL	MG/KG	107	70.8	117	71.7	49.6	86 J	79.8 J	36 J
SVOCs									
1,2,4-TRICHLOROBENZENE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
1,2-DICHLOROBENZENE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
1,3-DICHLOROBENZENE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
1,4-DICHLOROBENZENE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
2,4,5-TRICHLOROPHENOL	UG/KG	830 U	890 U	820 U	840 U	820 U	860 U	880 U	830 U
2,4,6-TRICHLOROPHENOL	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
2,4-DICHLOROPHENOL	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
2,4-DIMETHYLPHENOL	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
2,4-DINITROPHENOL	UG/KG	830 U	890 U	820 U	840 U	820 U	860 U	880 UJ	830 U
2-CHLORONAPHTHALENE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
2-CHLOROPHENOL	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
2-METHYL-4,6-DINITROPHENOL	UG/KG	830 U	890 U	820 U	840 U	820 U	860 U	880 U	830 U
2-METHYLNAPHTHALENE	UG/KG	37 J	370 U	32 J	350 U	24 J	350 U	360 U	340 U
2-METHYLPHENOL (O-CRESOL)	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
2-NITROANILINE	UG/KG	830 U	890 U	820 U	840 U	820 U	860 U	880 U	830 U
2-NITROPHENOL	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
3,3'-DICHLOROBENZIDINE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 UJ	360 U	340 UJ
3-NITROANILINE	UG/KG	830 U	890 U	820 U	840 U	820 U	860 U	880 U	830 U
4-BROMOPHENYL PHENYL ETHER	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
4-CHLORO-3-METHYLPHENOL	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
4-CHLOROANILINE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
4-CHLOROPHENYL PHENYL ETHER	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
4-METHYLPHENOL (P-CRESOL)	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
4-NITROANILINE	UG/KG	830 U	890 U	820 U	840 U	820 U	860 U	880 U	830 U
4-NITROPHENOL	UG/KG	830 U	890 U	820 U	840 U	820 U	860 UJ	880 U	830 UJ
ACENAPHTHENE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
ACENAPHTHYLENE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
ANTHRACENE	UG/KG	18 J	370 U	340 U	350 U	340 U	350 U	360 U	340 U
BENZO(A)ANTHRACENE	UG/KG	33 J	370 U	23 J	350 U	32 J	350 U	360 U	340 U
BENZO(A)PYRENE	UG/KG	28 J	370 U	24 J	350 U	32 J	350 U	360 U	340 U
BENZO(B)FLUORANTHENE	UG/KG	39 J	370 U	28 J	350 U	32 J	350 U	360 U	340 U
BENZO(G,H,I)PERYLENE	UG/KG	45 J	370 U	28 J	20 J	46 J	28 J	360 U	340 U
BENZO(K)FLUORANTHENE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
BIS(2-CHLOROETHOXY)METHANE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
BIS(2-CHLOROETHYL) ETHER	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	340 BU	370 BU	340 BU	350 BU	340 BU	350 BU	360 BU	100 BU

TABLE B[illegible]1
DR BACK[illegible]/ARMY/NAVY AREAS SURFACE SOIL SAMPLES
1995 SOU[illegible]ST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06SS-A10,D	06SS-A11	06SS-A12	06SS-A13	06SS-A14	06SS-A04	06SS-A05	06SS-A06
SAMPLE TYPE	UNITS	ARMY	ARMY	ARMY	ARMY	ARMY	NAVY	NAVY	NAVY
VOCs, cont.									
BUTYLBENZYLPHTHALATE	UG/KG	340 U	20 J	340 U	350 U	340 U	350 U	360 U	23 J
CARBAZOLE	UG/KG	23 J	370 U	21 J	350 U	340 U	350 U	360 U	340 U
CHRYSENE	UG/KG	43 J	370 U	26 J	24 J	48 J	23 J	360 U	340 U
DI-N-BUTYL PHTHALATE	UG/KG	190 J	28 J	270 J	45 J	83 J	36 J	18 J	19 J
DI-N-OCTYL PHTHALATE	UG/KG	340 U	370 U	340 U	350 U	18 J	350 U	360 U	340 U
DIBENZO(A,H)ANTHRACENE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
DIBENZOFURAN	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
DIETHYL PHTHALATE	UG/KG	39 J	370 U	49 J	200 J	18 J	350 U	360 U	340 U
DIMETHYL PHTHALATE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
FLUORANTHENE	UG/KG	76 J	25 J	50 J	40 J	71 J	45 J	360 U	340 U
FLUORENE	UG/KG	21 J	370 U	340 U	350 U	340 U	350 U	360 U	340 U
HEXACHLOROBENZENE	UG/KG	20 J	370 U	340 U	350 U	340 U	36 J	360 U	340 U
HEXACHLOROBUTADIENE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
HEXACHLOROCYCLOPENTADIENE	UG/KG	340 UJ	370 UJ	340 UJ	350 UJ	340 UJ	350 UJ	360 UJ	340 UJ
HEXACHLOROETHANE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
INDENO(1,2,3-CD)PYRENE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
ISOPHORONE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
N-NITROSO-DI-N-PROPYLAMINE	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 UJ	340 U
N-NITROSODIPHENYLAMINE	UG/KG	23 J	370 U	340 U	330 J	340 U	350 U	360 U	340 U
NAPHTHALENE	UG/KG	63 J	30 J	63 J	32 J	38 J	350 U	360 U	340 U
PENTACHLOROPHENOL	UG/KG	24 J	890 U	820 U	840 U	19 J	860 U	880 U	830 U
PHENANTHRENE	UG/KG	130 J	24 J	75 J	58 J	100 J	44 J	360 U	340 U
PHENOL	UG/KG	340 U	370 U	340 U	350 U	340 U	350 U	360 U	340 U
PYRENE	UG/KG	150 J	44 J	87 J	65 J	120 J	43 J	360 U	340 U

TABLE B-3.c.1a
DR BOGGS CREEK SURFACE WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		SW	SW	SW
ANALYTES	UNITS	06-SW-B1	06-SW-B2	06-SW-B3
EXPLOSIVES				
1,3-DINITROBENZENE	UG/L	4.00 U	4.00 U	4.00 U
1,3,5-TRINITROBENZENE	UG/L	7.30 U	7.30 U	7.30 U
2,4-DINITROTOLUENE	UG/L	5.70 U	5.70 U	5.70 U
2,4-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U
2,4,6-TRINITROTOLUENE (TNT)	UG/L	6.40 U	6.40 U	6.40 U
2,6-DINITROTOLUENE	UG/L	9.40 U	9.40 U	9.40 U
2,6-DINITROTOLUENE(2)	UG/L	10 U	10 U	10 U
HMX	UG/L	13 U	13 U	13 U
M-NITROTOLUENE	UG/L	7.90 U	7.90 U	7.90 U
NITROBENZENE	UG/L	7.00 U	7.00 U	7.00 U
NITROBENZENE(2)	UG/L	10 U	10 U	10 U
O-NITROTOLUENE	UG/L	12 U	12 U	12 U
P-NITROTOLUENE	UG/L	8.00 U	8.00 U	8.00 U
RDX	UG/L	14 U	14 U	14 U
TETRYL	UG/L	10 U	10 U	10 U
INORGANICS				
ALUMINUM, TOTAL	UG/L	25.6 J	246 J	158 J
ANTIMONY, TOTAL	UG/L	3.00 UJ	3.00 UJ	3.00 UJ
ARSENIC, TOTAL	UG/L	3.30 J	2.00 UJ	2.00 UJ
BARIUM, TOTAL	UG/L	48.4 J	53.9 J	44.7 J
BERYLLIUM, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ
CADMIUM, TOTAL	UG/L	2.10 J	10.7 J	2.70 J
CALCIUM, TOTAL	UG/L	38200 J	39400 J	36800 J
CHROMIUM, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ
COBALT, TOTAL	UG/L	1.00 UJ	28.8 J	4.90 J
COPPER, TOTAL	UG/L	3.20 J	44.1 J	16.4 J
CYANIDE	UG/L	3.00 UJ	3.00 UJ	3.00 UJ
IRON, TOTAL	UG/L	44.1 J	348 J	187 J
LEAD, TOTAL	UG/L	1.00 UJ	2.00 J	1.00 UJ
MAGNESIUM, TOTAL	UG/L	7670 J	11400 J	8470 J
MANGANESE, TOTAL	UG/L	32.5 J	2000 J	506 J
MERCURY, TOTAL	UG/L	0.20 UJ	0.20 UJ	0.20 UJ
NICKEL, TOTAL	UG/L	1.50 J	39.6 J	11 J
POTASSIUM, TOTAL	UG/L	5090 J	4390 J	3850 J
SELENIUM, TOTAL	UG/L	2.00 UJ	2.00 UJ	2.00 UJ
SILVER, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ
THALLIUM, TOTAL	UG/L	2.10 J	2.00 UJ	2.00 UJ
VANADIUM, TOTAL	UG/L	1.00 UJ	1.00 UJ	1.00 UJ
ZINC, TOTAL	UG/L	9.90 J	210 J	49.1 J

TABLE B-3.c.1a
DR BOGGS CREEK SURFACE WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		SW	SW	SW
ANALYTES	UNITS	06-SW-B1	06-SW-B2	06-SW-B3
SVOCs				
1,2-DICHLOROBENZENE	UG/L	10 U	10 U	10 U
1,2,4-TRICHLOROBENZENE	UG/L	10 U	10 U	10 U
1,3-DICHLOROBENZENE	UG/L	10 U	10 U	10 U
1,4-DICHLOROBENZENE	UG/L	10 U	10 U	10 U
2-CHLORONAPHTHALENE	UG/L	10 U	10 U	10 U
2-CHLOROPHENOL	UG/L	10 U	10 U	10 U
2-METHYL-4,6-DINITROPHENOL	UG/L	25 U	25 U	25 U
2-METHYLNAPHTHALENE	UG/L	10 U	10 U	10 U
2-METHYLPHENOL (O-CRESOL)	UG/L	10 U	10 U	10 U
2-NITROANILINE	UG/L	25 U	25 U	25 U
2-NITROPHENOL	UG/L	10 U	10 U	10 U
2,4-DICHLOROPHENOL	UG/L	10 U	10 U	10 U
2,4-DIMETHYLPHENOL	UG/L	10 U	10 U	10 U
2,4-DINITROPHENOL	UG/L	25 U	25 UJ	25 U
2,4,5-TRICHLOROPHENOL	UG/L	25 U	25 U	25 U
2,4,6-TRICHLOROPHENOL	UG/L	10 U	10 U	10 U
3-NITROANILINE	UG/L	25 U	25 U	25 U
3,3'-DICHLOROBENZIDINE	UG/L	10 UJ	10 U	10 U
4-BROMOPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U
4-CHLORO-3-METHYLPHENOL	UG/L	10 U	10 U	10 U
4-CHLOROANILINE	UG/L	10 U	10 U	10 U
4-CHLOROPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U
4-METHYLPHENOL (P-CRESOL)	UG/L	10 U	10 U	10 U
4-NITROANILINE	UG/L	25 U	25 U	25 U
4-NITROPHENOL	UG/L	25 UJ	25 U	25 U
ACENAPHTHENE	UG/L	10 U	10 U	10 U
ACENAPHTHYLENE	UG/L	10 U	10 U	10 U
ANTHRACENE	UG/L	10 U	10 U	10 U
BENZO(A)ANTHRACENE	UG/L	10 U	10 U	10 U
BENZO(A)PYRENE	UG/L	10 U	10 U	10 U
BENZO(B)FLUORANTHENE	UG/L	10 U	10 U	10 U
BENZO(G,H,I)PERYLENE	UG/L	10 U	10 U	10 U
BENZO(K)FLUORANTHENE	UG/L	10 U	10 U	10 U
BIS(2-CHLOROETHOXY)METHANE	UG/L	10 U	10 U	10 U
BIS(2-CHLOROETHYL) ETHER	UG/L	10 U	10 U	10 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 U	10 U	10 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	10 U	10 U	10 BU
BUTYLBENZYLPHTHALATE	UG/L	10 U	10 U	10 U
CARBAZOLE	UG/L	10 U	10 U	10 U

TABLE B-3.c.1a
DR BOGGS CREEK SURFACE WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		SW	SW	SW
ANALYTES	UNITS	06-SW-B1	06-SW-B2	06-SW-B3
SVOCs, cont.				
CHRYSENE	UG/L	10 U	10 U	10 U
DIBENZOFURAN	UG/L	10 U	10 U	10 U
DIBENZO(A,H)ANTHRACENE	UG/L	10 U	10 U	10 U
DIETHYL PHTHALATE	UG/L	10 U	10 U	10 U
DIMETHYL PHTHALATE	UG/L	10 U	10 U	10 U
DI-N-BUTYL PHTHALATE	UG/L	10 U	10 U	10 U
DI-N-OCTYL PHTHALATE	UG/L	10 U	10 U	10 U
FLUORANTHENE	UG/L	10 U	10 U	10 U
FLUORENE	UG/L	10 U	10 U	10 U
HEXACHLOROBENZENE	UG/L	10 U	10 U	10 U
HEXACHLOROBUTADIENE	UG/L	10 U	10 U	10 U
HEXACHLOROCYCLOPENTADIENE	UG/L	10 UJ	10 UJ	10 UJ
HEXACHLOROETHANE	UG/L	10 U	10 U	10 U
INDENO(1,2,3-CD)PYRENE	UG/L	10 U	10 U	10 U
ISOPHORONE	UG/L	10 U	10 U	10 U
NAPHTHALENE	UG/L	10 U	10 U	10 U
N-NITROSO-DI-N-PROPYLAMINE	UG/L	10 U	10 UJ	10 U
N-NITROSODIPHENYLAMINE	UG/L	10 U	10 U	10 U
PENTACHLOROPHENOL	UG/L	25 U	25 U	25 U
PHENANTHRENE	UG/L	10 U	10 U	10 U
PHENOL	UG/L	10 U	10 U	10 U
PYRENE	UG/L	10 U	10 U	10 U
VOCs				
1,1-DICHLOROETHANE	UG/L	10 U	10 U	10 U
1,1-DICHLOROETHENE	UG/L	10 U	10 U	10 U
1,1,1-TRICHLOROETHANE	UG/L	10 U	10 U	10 U
1,1,2-TRICHLOROETHANE	UG/L	10 U	10 U	10 U
1,1,2,2-TETRACHLOROETHANE	UG/L	10 U	10 U	10 U
1,2-DICHLOROETHANE	UG/L	10 U	10 U	10 U
1,2-DICHLOROETHENE(TOTAL)	UG/L	10 U	10 U	10 U
1,2-DICHLOROPROPANE	UG/L	10 U	10 U	10 U
2-BUTANONE (MEK)	UG/L	10 UJ	10 UJ	10 UJ
2-HEXANONE	UG/L	10 U	10 U	10 U
4-METHYL-2-PENTANONE (MIBK)	UG/L	10 U	10 U	10 U
ACETONE	UG/L	10 U	10 U	10 U
BENZENE	UG/L	10 U	10 U	10 U
BROMODICHLOROMETHANE	UG/L	10 U	10 U	10 U
BROMOFORM	UG/L	10 U	10 U	10 U
BROMOMETHANE (METHYL BROMIDE)	UG/L	10 U	10 U	10 U

TABLE B-3.c.1a
DR BOGGS CREEK SURFACE WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		SW	SW	SW
ANALYTES	UNITS	06-SW-B1	06-SW-B2	06-SW-B3
VOCs, cont.				
CARBON DISULFIDE	UG/L	10 U	10 U	10 U
CARBON TETRACHLORIDE	UG/L	10 U	10 U	10 U
CHLOROBENZENE	UG/L	10 U	10 U	10 U
CHLOROETHANE	UG/L	10 UJ	10 UJ	10 UJ
CHLOROFORM	UG/L	1.00 J	10 U	10 U
CHLOROMETHANE (METHYL CHLORIDE	UG/L	10 UJ	10 UJ	10 UJ
CIS-1,3-DICHLOROPROPENE	UG/L	10 U	10 U	10 U
DIBROMOCHLOROMETHANE	UG/L	10 U	10 U	10 U
ETHYLBENZENE	UG/L	10 U	10 U	10 U
METHYLENE CHLORIDE	UG/L	10 BU	10 BU	10 BU
STYRENE	UG/L	10 U	10 U	10 U
TETRACHLOROETHENE	UG/L	10 U	10 U	10 U
TOLUENE	UG/L	10 U	10 U	10 U
TRANS-1,3-DICHLOROPROPENE	UG/L	10 U	10 U	10 U
TRICHLOROETHENE	UG/L	10 U	1.00 J	10 U
VINYL CHLORIDE	UG/L	10 U	10 U	10 U
XYLENE, TOTAL	UG/L	10 U	10 U	10 U
WATER QUALITY PARAMETER				
ALKALINITY	MG/L	85	67	75
CHEMICAL OXYGEN DEMAND	MG/L	10 U	14.8	12.6
CHLORIDE	MG/L	25.1	21.8	23.1
NITROGEN (NO2+NO3)	MG/L	3.50	1.80	1.60
SODIUM, TOTAL	MG/L	20500 J	17700 J	18900 J
SULFATE	MG/L	54.2	77.2	50.4
TOTAL DISSOLVED SOLIDS	MG/L	250	240	220

TABLE B-3.c.1b
DR BOGGS CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06-SED-B1	06-SED-B2	06-SED-B3
ANALYTES	UNITS	Sediment	Sediment	Sediment
EXPLOSIVES				
1,3-DINITROBENZENE	UG/KG	250 U	250 U	250 U
1,3,5-TRINITROBENZENE	UG/KG	250 UR	250 UR	250 UR
2,4-DINITROTOLUENE	UG/KG	390 U	420 U	420 U
2,4-DINITROTOLUENE,(2)	UG/KG	250 U	250 U	250 U
2,4,6-TRINITROTOLUENE (TNT)	UG/KG	250 UJ	250 UJ	250 UJ
2,6-DINITROTOLUENE	UG/KG	390 U	420 U	420 U
2,6-DINITROTOLUENE,(2)	UG/KG	260 U	260 U	260 U
HMX	UG/KG	2200 U	2200 U	2200 U
M-NITROTOLUENE	UG/KG	250 U	250 U	250 U
NITROBENZENE	UG/KG	390 U	420 U	420 U
NITROBENZENE,(2)	UG/KG	260 U	260 U	260 U
O-NITROTOLUENE	UG/KG	250 U	250 U	250 U
P-NITROTOLUENE	UG/KG	250 U	250 U	250 U
RDX	UG/KG	1000 U	1000 U	1000 U
TETRYL	UG/KG	650 U	650 U	650 U
INORGANICS				
ALUMINUM, TOTAL	MG/KG	5180 J	3260 J	3870 J
ANTIMONY, TOTAL	MG/KG	3.60 J	0.80 UJ	0.79 UJ
ARSENIC, TOTAL	MG/KG	24.8	7.40	7.40
BARIUM, TOTAL	MG/KG	90.9	54.5	52.7
BERYLLIUM, TOTAL	MG/KG	2.90	0.90	0.66
CADMIUM, TOTAL	MG/KG	11.2 J	0.58 U	0.92 U
CALCIUM, TOTAL	MG/KG	1460 J	551 J	601 J
CHROMIUM, TOTAL	MG/KG	76.7	12.9	12.1 J
COBALT, TOTAL	MG/KG	22	11	8.50
COPPER, TOTAL	MG/KG	18.3 J	11.3 J	12.7 J
CYANIDE	MG/KG	0.27 J	0.20 UR	0.20 UR
IRON, TOTAL	MG/KG	93300 J	13900 J	16200 J
LEAD, TOTAL	MG/KG	23.5 J	10.3 J	10.4 J
MAGNESIUM, TOTAL	MG/KG	779	321	561 J
MANGANESE, TOTAL	MG/KG	1290 J	215 J	494 J
MERCURY, TOTAL	MG/KG	0.12 U	0.13 U	0.13 U
NICKEL, TOTAL	MG/KG	44.6	16.3	12.1 J
POTASSIUM, TOTAL	MG/KG	670 U	503 U	685 U
SELENIUM, TOTAL	MG/KG	1.10	0.64	0.89
SILVER, TOTAL	MG/KG	0.24 U	0.27 U	0.26 U
THALLIUM, TOTAL	MG/KG	3.00 J	0.96 U	0.52 U
VANADIUM, TOTAL	MG/KG	44.2	12	13.1
ZINC, TOTAL	MG/KG	388 J	52.4 J	45.1 J

TABLE B-3.c.1b
DR BOGGS CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
SK ASSESSMENT
AVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06-SED-B1	06-SED-B2	06-SED-B3
ANALYTES	UNITS	Sediment	Sediment	Sediment
SVOCs				
1,2-DICHLOROBENZENE	UG/KG	390 U	420 U	420 U
1,2,4-TRICHLOROBENZENE	UG/KG	390 U	420 U	420 U
1,3-DICHLOROBENZENE	UG/KG	390 U	420 U	420 U
1,4-DICHLOROBENZENE	UG/KG	390 U	420 U	420 U
2-CHLORONAPHTHALENE	UG/KG	390 U	420 U	420 U
2-CHLOROPHENOL	UG/KG	390 U	420 U	420 U
2-METHYL-4,6-DINITROPHENOL	UG/KG	950 U	1000 U	1000 U
2-METHYLNAPHTHALENE	UG/KG	390 U	420 U	420 U
2-METHYLPHENOL (O-CRESOL)	UG/KG	390 U	420 U	420 U
2-NITROANILINE	UG/KG	950 U	1000 U	1000 U
2-NITROPHENOL	UG/KG	390 U	420 U	420 U
2,4-DICHLOROPHENOL	UG/KG	390 U	420 U	420 U
2,4-DIMETHYLPHENOL	UG/KG	390 U	420 U	420 U
4-DINITROPHENOL	UG/KG	950 UJ	1000 U	1000 UJ
,4,5-TRICHLOROPHENOL	UG/KG	950 U	1000 U	1000 U
,4,6-TRICHLOROPHENOL	UG/KG	390 U	420 U	420 U
3-NITROANILINE	UG/KG	950 U	1000 U	1000 U
3,3'-DICHLOROBENZIDINE	UG/KG	390 U	420 UJ	420 U
4-BROMOPHENYL PHENYL ETHER	UG/KG	390 U	420 U	420 U
4-CHLORO-3-METHYLPHENOL	UG/KG	390 U	420 U	420 U
4-CHLOROANILINE	UG/KG	390 U	420 U	420 U
4-CHLOROPHENYL PHENYL ETHER	UG/KG	390 U	420 U	420 U
4-METHYLPHENOL (P-CRESOL)	UG/KG	390 U	420 U	420 U
4-NITROANILINE	UG/KG	950 U	1000 U	1000 U
4-NITROPHENOL	UG/KG	950 U	1000 UJ	1000 U
ACENAPHTHENE	UG/KG	390 U	420 U	420 U
ACENAPHTHYLENE	UG/KG	390 U	420 U	420 U
ANTHRACENE	UG/KG	390 U	420 U	420 U
BENZO(A)ANTHRACENE	UG/KG	390 U	420 U	420 U
BENZO(A)PYRENE	UG/KG	390 U	420 U	420 U
BENZO(B)FLUORANTHENE	UG/KG	390 U	420 U	420 U
BENZO(G,H,I)PERYLENE	UG/KG	390 U	420 U	420 U
BENZO(K)FLUORANTHENE	UG/KG	390 U	420 U	420 U
BIS(2-CHLOROETHOXY)METHANE	UG/KG	390 U	420 U	420 U
BIS(2-CHLOROETHYL) ETHER	UG/KG	390 U	420 U	420 U
S(2-CHLOROISOPROPYL) ETHER	UG/KG	390 U	420 U	420 U
S(2-ETHYLHEXYL) PHTHALATE	UG/KG	390 BU	420 BU	420 BU
UTYLBENZYLPHTHALATE	UG/KG	21 J	26 J	420 U
CARBAZOLE	UG/KG	390 U	420 U	420 U

TABLE B-3.c.1b
DR BOGGS CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06-SED-B1	06-SED-B2	06-SED-B3
ANALYTES	UNITS	Sediment	Sediment	Sediment
SVOCs, cont.				
CHRYSENE	UG/KG	390 U	420 U	420 U
DIBENZOFURAN	UG/KG	390 U	420 U	420 U
DIBENZO(A,H)ANTHRACENE	UG/KG	390 U	420 U	420 U
DIETHYL PHTHALATE	UG/KG	390 U	420 U	420 U
DIMETHYL PHTHALATE	UG/KG	390 U	420 U	420 U
DI-N-BUTYL PHTHALATE	UG/KG	390 U	29 J	24 J
DI-N-OCTYL PHTHALATE	UG/KG	390 U	420 U	420 U
FLUORANTHENE	UG/KG	390 U	420 U	420 U
FLUORENE	UG/KG	390 U	420 U	420 U
HEXACHLOROBENZENE	UG/KG	390 U	420 U	420 U
HEXACHLOROBUTADIENE	UG/KG	390 U	420 U	420 U
HEXACHLOROCYCLOPENTADIENE	UG/KG	390 UJ	420 UJ	420 UJ
HEXACHLOROETHANE	UG/KG	390 U	420 U	420 U
INDENO(1,2,3-CD)PYRENE	UG/KG	390 U	420 U	420 U
ISOPHORONE	UG/KG	390 U	420 U	420 U
NAPHTHALENE	UG/KG	390 U	420 U	420 U
N-NITROSO-DI-N-PROPYLAMINE	UG/KG	390 UJ	420 U	420 UJ
N-NITROSODIPHENYLAMINE	UG/KG	390 U	420 U	420 U
PENTACHLOROPHENOL	UG/KG	950 U	1000 U	1000 U
PHENANTHRENE	UG/KG	390 U	420 U	420 U
PHENOL	UG/KG	390 U	420 U	420 U
PYRENE	UG/KG	390 U	420 U	420 U
VOCs				
1,1-DICHLOROETHANE	UG/KG	12 U	13 U	13 U
1,1-DICHLOROETHENE	UG/KG	12 U	13 U	13 U
1,1,1-TRICHLOROETHANE	UG/KG	12 U	13 U	13 U
1,1,2-TRICHLOROETHANE	UG/KG	12 U	13 U	13 U
1,1,2,2-TETRACHLOROETHANE	UG/KG	12 U	13 U	13 U
1,2-DICHLOROETHANE	UG/KG	12 U	13 U	13 U
1,2-DICHLOROETHENE(TOTAL)	UG/KG	12 U	13 U	13 U
1,2-DICHLOROPROPANE	UG/KG	12 U	13 U	13 U
2-BUTANONE (MEK)	UG/KG	12 U	18 J	13 U
2-HEXANONE	UG/KG	12 U	13 UJ	13 UJ
4-METHYL-2-PENTANONE (MIBK)	UG/KG	12 U	13 U	13 U
ACETONE	UG/KG	7.00 J	62	16
BENZENE	UG/KG	12 U	13 U	13 U
BROMODICHLOROMETHANE	UG/KG	12 U	13 U	13 U
BROMOFORM	UG/KG	12 U	13 U	13 U
BROMOMETHANE (METHYL BROMIDE)	UG/KG	12 U	13 U	13 U

TABLE B-3.c.1b
DR BOGGS CREEK SEDIMENT SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06-SED-B1	06-SED-B2	06-SED-B3
ANALYTES	UNITS	Sediment	Sediment	Sediment
VOCs, cont.				
CARBON DISULFIDE	UG/KG	12 U	13 U	13 U
CARBON TETRACHLORIDE	UG/KG	12 U	13 U	13 U
CHLOROBENZENE	UG/KG	12 U	13 U	13 U
CHLOROETHANE	UG/KG	12 U	13 U	13 U
CHLOROFORM	UG/KG	12 U	13 U	13 U
CHLOROMETHANE (METHYL CHLORIDE	UG/KG	12 U	13 U	13 U
CIS-1,3-DICHLOROPROPENE	UG/KG	12 U	13 U	13 U
DIBROMOCHLOROMETHANE	UG/KG	12 U	13 U	13 U
ETHYLBENZENE	UG/KG	12 U	13 U	13 U
METHYLENE CHLORIDE	UG/KG	12 U	13 BU	14 BU
STYRENE	UG/KG	12 U	13 U	13 U
TETRACHLOROETHENE	UG/KG	12 U	13 U	13 U
TOLUENE	UG/KG	12 U	13 U	14
TRANS-1,3-DICHLOROPROPENE	UG/KG	12 U	13 U	13 U
TRICHLOROETHENE	UG/KG	12 U	13 U	13 U
VINYL CHLORIDE	UG/KG	12 U	13 U	13 U
XYLENE, TOTAL	UG/KG	12 U	13 U	13 U
WATER QUALITY PARAMETER				
NITROGEN (NO2+NO3)	MG/KG	1.19 U	1.29 U	1.29 U
SODIUM, TOTAL	MG/KG	34.6 UJ	67.2	60.8

TABLE B-3.d.1
DR GROUND WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06C01	06C01,D	06C03	06C06	06C07	06-01A	06-01A,R	06-07	06C03P2	06C04P2	06C06P2	06C08P2
ANALYTES	UNITS	BCH	BCH	BCH	BCH	BCH	SURF	SURF	SURF	SURF	SURF	SURF	SURF
EXPLOSIVES													
1,3-DINITROBENZENE	UG/L	4.00 U	4.00 U	4.00 U	4.00 U	4.00 U	4.00 U		4.00 U	4.00 U	4.00 U	4.00 U	4.00 U
1,3,5-TRINITROBENZENE	UG/L	7.30 U	7.30 U	7.30 U	7.30 U	7.30 U	7.30 U		7.30 U	7.30 U	7.30 U	7.30 U	7.30 U
2,4-DINITROTOLUENE	UG/L	5.70 U	5.70 U	5.70 U	5.70 U	5.70 U	5.70 U		5.70 U	5.70 U	5.70 U	5.70 U	5.70 U
2,4-DINITROTOLUENE(OLM01.8)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
2,4,6-TRINITROTOLUENE (TNT)	UG/L	6.40 U	6.40 U	6.40 U	6.40 U	6.40 U	6.40 U		6.40 U	6.40 U	6.40 U	6.40 U	6.40 U
2,6-DINITROTOLUENE	UG/L	9.40 U	9.40 U	9.40 U	9.40 U	9.40 U	9.40 U		9.40 U	9.40 U	9.40 U	9.40 U	9.40 U
2,6-DINITROTOLUENE(OLM01.8)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
HMX	UG/L	13 U	13 U	13 U	13 U	13 U	13 U		13 U	13 U	13 U	13 U	13 U
M-NITROTOLUENE	UG/L	7.90 U	7.90 U	7.90 U	7.90 U	7.90 U	7.90 U		7.90 U	7.90 U	7.90 U	7.90 U	7.90 U
NITROBENZENE	UG/L	7.00 U	7.00 U	7.00 U	7.00 U	7.00 U	7.00 U		7.00 U	7.00 U	7.00 U	7.00 U	7.00 U
NITROBENZENE(OLM01.8)	UG/L	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 U	10 UJ	10 U	10 UJ	10 U	10 UJ	10 UJ
O-NITROTOLUENE	UG/L	12 U	12 U	12 U	12 U	12 U	12 U		12 U	12 U	12 U	12 U	12 U
P-NITROTOLUENE	UG/L	8.00 U	8.00 U	8.00 U	8.00 U	8.00 U	8.00 U		8.00 U	8.00 U	8.00 U	8.00 U	8.00 U
RDX	UG/L	14 U	14 U	14 U	14 U	14 U	36		14 U	14 U	14 U	14 U	14 U
TETRYL	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
INORGANICS													
ALUMINUM, TOTAL	UG/L	33.4	22.4	8.00 U	62.7 U	11.6	841 J		81800 J	1440 J	2340 J	3580 J	790
ANTIMONY, TOTAL	UG/L	3.00 U	3.00 U	3.00 U	3.00 U	3.00 U	3.00 UJ		3.00 UJ	3.00 U	3.00 UJ	3.00 U	3.00 U
ARSENIC, TOTAL	UG/L	2.00 U	2.00 U	13.1	2.00 U	2.00 U	2.00 J		35 J	2.00 U	3.60 J	5.00	6.20
BARIUM, TOTAL	UG/L	96.7	93.8	84.5	42.3	6.90	43.3 J		14.8 J	61.1	33.7 J	42.5	14.4
BERYLLIUM, TOTAL	UG/L	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 UJ		9.10 J	1.00 U	1.00 UJ	1.00 U	1.70
CADMIUM, TOTAL	UG/L	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 UJ		5.80 J	1.00 U	1.00 UJ	1.00 U	1.00 U
CALCIUM, TOTAL	UG/L	54000 J	52200 J	53400 J	9220 J	160 UJ	107000 J		139000 J	79100 J	84900 J	10200 J	9370 J
CHROMIUM, TOTAL	UG/L	2.50	2.90	1.00 U	1.20 U	2.20	4.40 UJ		19.3 J	24.2 J	8.60 J	18.3 J	3.80
COBALT, TOTAL	UG/L	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	7.90 J		265 J	1.90	1.60 J	3.20	7.60
COPPER, TOTAL	UG/L	2.00	1.90	1.00 U	1.00 U	1.00 U	3.70 J		6.60 J	3.90 U	6.00 J	10.4 J	1.90
CYANIDE	UG/L	3.00 U	3.00 U	3.00 U	3.00 U	3.00 U	3.00 UJ		3.00 UJ	3.00 U	3.00 UJ	3.00 U	3.00 U
IRON, TOTAL	UG/L	62 U	54.7 U	7030 J	329	23.5 U	2280 J		46700 J	1690	4570 J	8310	17100 J
LEAD, TOTAL	UG/L	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	2.50 J		2.00 J	1.20 U	3.30 J	6.20 U	1.00 U
MAGNESIUM, TOTAL	UG/L	10700 J	10200 J	11600 J	4900	75.5 U	71200 J		147000 J	19400	37900 J	5260	6240 J
MANGANESE, TOTAL	UG/L	64.5	62.1	384 J	58.5 J	1.00 U	373 J		6640 J	37.5 J	499 J	90.3 J	632
MERCURY, TOTAL	UG/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.20 UJ		0.20 UJ	0.2 U	0.20 UJ	0.2 U	0.2 U
NICKEL, TOTAL	UG/L	2.80 U	3.30 U	1.00 U	1.40 U	1.00 U	14.7 J		1060 J	9.60 J	8.80 J	9.10 J	31.4 J
POTASSIUM, TOTAL	UG/L	2340 U	1150 U	1790 U	1040 U	834 U	4230 UJ		4230 UJ	3160	6000 J	1860	2290 U
SELENIUM, TOTAL	UG/L	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 UJ		2.00 UJ	2.00 U	2.00 UJ	2.00 U	2.00 U
SILVER, TOTAL	UG/L	1.00 U	1.00 U	1.00 U	1.00 U	1.00	1.00 UJ		1.00 UJ	1.00 U	1.00 UJ	1.00 U	1.00 U
THALLIUM, TOTAL	UG/L	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.10 UJ		4.70 UJ	2.00 U	2.90 UJ	2.00 U	2.00 U
VANADIUM, TOTAL	UG/L	1.40	1.50	1.00 U	1.00 U	1.00 U	2.10 J		16.3 J	1.70	2.80 J	9.30	1.70
ZINC, TOTAL	UG/L	8.80 J	7.10 J	1.60 U	3.40 U	1.50 U	18.8 J		1820 J	11.9 J	20.6 J	31.7 J	38.8 J

TABLE B[illegible] 1
DR GRO[illegible]ER SAMPLE RESULTS
1995 SO[illegible]T LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06C01	06C01,D	06C03	06C06	06C07	06-01A	06-01A,R	06-07	06C03P2	06C04P2	06C06P2	06C08P2
ANALYTES	UNITS	BCH	BCH	BCH	BCH	BCH	SURF	SURF	SURF	SURF	SURF	SURF	SURF
SVOCs													
1,2-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
1,2,4-TRICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
1,3-DICHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
1,4-DICHLOROBENZENE	UG/L	0.7 J	0.9 J	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
2-CHLORONAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
2-CHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	10 U	10 U
2-METHYL-4,6-DINITROPHENOL	UG/L	25 U	25 U	25 U	25 U	25 U	25 UJ	25 UJ	25 U	25 U	25 U	25 U	25 U
2-METHYLNAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
2-METHYLPHENOL (O-CRESOL)	UG/L	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	10 U	10 U
2-NITROANILINE	UG/L	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 U	25 UJ	25 U	25 UJ	25 U	25 UJ	25 UJ
2-NITROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	10 U	10 U
2,4-DICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	10 U	10 U
2,4-DIMETHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	10 U	10 U
2,4-DINITROPHENOL	UG/L	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 UJ	25 U	25 UJ	25 U	25 UJ	25 UJ
2,4,5-TRICHLOROPHENOL	UG/L	25 U	25 U	25 U	25 U	25 U	25 UJ	25 UJ	25 U	25 U	25 U	25 U	25 U
2,4,6-TRICHLOROPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	1.00 J	1.00 J
3-NITROANILINE	UG/L	25 U	25 U	25 U	25 U	25 U	25 U	25 UJ	25 U	25 U	25 U	25 U	25 U
3,3'-DICHLOROBENZIDINE	UG/L	10 U	10 U	10 U	10 U	10 UJ	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
4-BROMOPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
4-CHLORO-3-METHYLPHENOL	UG/L	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	10 U	10 U
4-CHLOROANILINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
4-CHLOROPHENYL PHENYL ETHER	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
4-METHYLPHENOL (P-CRESOL)	UG/L	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	10 U	10 U
4-NITROANILINE	UG/L	25 U	25 U	25 U	25 U	25 U	25 UJ	25 UJ	25 UJ	25 U	25 UJ	25 U	25 U
4-NITROPHENOL	UG/L	25 U	25 U	25 U	25 U	25 U	25 UJ	25 UJ	25 U	25 U	25 U	25 U	25 U
ACENAPHTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
ACENAPHTHYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
BENZO(A)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
BENZO(A)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
BENZO(B)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
BENZO(G,H,I)PERYLENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
BENZO(K)FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHOXY)METHANE	UG/L	10 U	10 U	10 U	10 U	10 UJ	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
BIS(2-CHLOROETHYL) ETHER	UG/L	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 UJ	10 U	10 UJ	10 U	10 UJ	10 UJ
BIS(2-CHLOROISOPROPYL) ETHER	UG/L	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 UJ	10 U	10 UJ	10 U	10 UJ	10 UJ
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 BUJ	10 BU	16 J	10 BU	10 U	0.6 J
BUTYLBENZYLPHTHALATE	UG/L	3.00 J	2.00 J	1.00 J	2.00 J	10 U	10 U	10 UJ	10 U	5.00 J	10 U	10 U	10 U
CARBAZOLE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U

TABLE B-3.d.1
DR GROUND WATER SAMPLE RESULTS
1995 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06C01	06C01,D	06C03	06C06	06C07	06-01A	06-01A,R	06-07	06C03P2	06C04P2	06C06P2	06C08P2
ANALYTES	UNITS	BCH	BCH	BCH	BCH	BCH	SURF	SURF	SURF	SURF	SURF	SURF	SURF
SVOCs, cont.													
CHRYSENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
DIBENZOFURAN	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
DIBENZO(A,H)ANTHRACENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
DIETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	0.6 J	10 U	10 UJ	10 U	10 U	10 U	10 U	0.6 J
DIMETHYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
DI-N-BUTYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
DI-N-OCTYL PHTHALATE	UG/L	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 UJ	10 U	10 U
FLUORANTHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
FLUORENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
HEXACHLOROBUTADIENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
HEXACHLOROCYCLOPENTADIENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
HEXACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
INDENO(1,2,3-CD)PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
ISOPHORONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
NAPHTHALENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.60 J	10 U	10 U	10 U	10 U	10 U
N-NITROSO-DI-N-PROPYLAMINE	UG/L	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	10 U	10 UJ	10 U	10 UJ	10 U	10 UJ	10 UJ
N-NITROSODIPHENYLAMINE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
PENTACHLOROPHENOL	UG/L	25 U	25 U	25 U	25 U	25 U	25 UJ	25 UJ	25 U	25 U	25 U	25 U	25 U
PHENANTHRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
PHENOL	UG/L	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 UJ	10 U	10 U	10 U	10 U	10 U
PYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
VOCs													
1,1-DICHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
1,1-DICHLOROETHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
1,1,1-TRICHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
1,1,2-TRICHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
1,1,2,2-TETRACHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROETHENE(TOTAL)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
1,2-DICHLOROPROPANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
2-BUTANONE (MEK)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
2-HEXANONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
4-METHYL-2-PENTANONE (MIBK)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
ACETONE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
BENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
BROMODICHLOROMETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
BROMOFORM	UG/L	10 U	10 U	10 U	10 U	10 U	10 UJ		10 UJ	10 U	10 UJ	10 U	10 U
BROMOMETHANE (METHYL BROMIDE)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U

TABLE B-3[illegible].1
DR GROU[illegible]TER SAMPLE RESULTS
1995 SOU[illegible]ST LAB
RISK ASSE[illegible]ENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		06C01	06C01,D	06C03	06C06	06C07	06-01A	06-01A,R	06-07	06C03P2	06C04P2	06C06P2	06C08P2
ANALYTES	UNITS	BCH	BCH	BCH	BCH	BCH	SURF	SURF	SURF	SURF	SURF	SURF	SURF
VOCs, cont.													
CARBON DISULFIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
CARBON TETRACHLORIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
CHLOROBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
CHLOROETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
CHLOROFORM	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
CHLOROMETHANE (METHYL CHLORIDE)	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
CIS-1,3-DICHLOROPROPENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
DIBROMOCHLOROMETHANE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
ETHYLBENZENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
METHYLENE CHLORIDE	UG/L	10 U	10 U	10 BU	10 BU	10 BU	22 BU		15 BU	10 BU	32 BU	10 BU	10 U
STYRENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
TETRACHLOROETHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
TOLUENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
TRANS-1,3-DICHLOROPROPENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
TRICHLOROETHENE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
VINYL CHLORIDE	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	10 U
XYLENE, TOTAL	UG/L	10 U	10 U	10 U	10 U	10 U	10 U		10 U	10 U	10 U	10 U	2.00 J
WATER QUALITY PARAMETER													
ALKALINITY	MG/L	201	197	215	378	20 U	246 J		20 U	231	365	25	20 U
CHEMICAL OXYGEN DEMAND	MG/L	10 U	10 U	10 U	10 U	10 U	12.6		27.9	10 U	10 U	10 U	10 U
CHLORIDE	MG/L	0.7	0.6	2.00	1.20	0.2 U	14.4		22.2	3.30	11.1	1.50	2.10
NITROGEN (NO2+NO3)	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.10 U		535	0.1 U	0.10 U	0.96	0.1 U
SODIUM, TOTAL	MG/L	14100	13600	18000 J	173000	142 U	96100 J		53800 J	16200	134000 J	12000	4530
SULFATE	MG/L	13.6	12.8	10.6	27.9	0.2 U	452		1500	70	204	28.8	77.7
TOTAL DISSOLVED SOLIDS	MG/L	710 J	680 J	600	1040	410 J	940 J		2270 J	800	630	830	640 J
CYCLOHEXANE	MG/L												

APPENDIX 2-4

SUPPLEMENTAL ENVIRONMENTAL MEDIA DATA

OBTAINED IN 1997 FOR ABG, ORR, AND DR

APPENDIX C

HNUS 1997 DATABASE

TABLE C-1.a.1
ABG SURFACE/[illegible]FACE SOIL SAMPLE RESULTS
1997 SOUTHWES[illegible]
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		030101	030201	030301	030401	030401, D	030501	030601	030701	031201	031301
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
EXPLOSIVES											
2,4-DINITROTOLUENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
2,6-DINITROTOLUENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
NITROBENZENE	UG/KG	400 U		390 U	410 UJ	400 UJ			410 U		
INORGANICS											
ALUMINUM, TOTAL	MG/KG	5940 J	6070 J	7300 J	4310 J	3470 J	4760 J	8540 J	7680 J	9920 J	3990 J
ANTIMONY, TOTAL	MG/KG	9 J	9.5 J	9.5 J	8.3 J	6.1 J	4.6 UJ	4.6 UJ	5.1 J	47.8 J	4.7 UJ
ARSENIC, TOTAL	MG/KG	7.9 J	6.1 J	6.8 J	4.6 J	5.3 J	6.9 J	5.8 J	10.5 J	22.2 J	4.8 J
BARIUM, TOTAL	MG/KG	66.3 J	42.4 J	215 J	65.3 J	55.3 J	33	1500	210	1430 J	68.1
BERYLLIUM, TOTAL	MG/KG	0.61 J	0.55 J	1.2 J	0.43	0.4	0.36	0.46	1.1	0.31	0.47
CADMIUM, TOTAL	MG/KG	1.2 UJ	1.3 UJ	1.2 UJ	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	15.8	1.2 U
CALCIUM, TOTAL	MG/KG	812 J	701 J	1060 J	7300 J	6290 J	762	31400	8400	121000 J	6790
CHROMIUM, TOTAL	MG/KG	12.7 J	9.2 J	11.4 J	8.5	7.8	11.8 J	21.9 J	14.7 J	24.3	9.2 J
COBALT, TOTAL	MG/KG	11.8 J	9.1 J	17.2 J	7.5	6.8	4.5	9.4	16	9.6	8.1
COPPER, TOTAL	MG/KG	8.2 J	5.1 J	8.1 J	24	17.6	9.2	204	46.1	5860	14.3
CYANIDE	MG/KG	0.56 U	0.53 U	0.54 U	0.54 U	0.61 U	0.57 UJ	0.57 UJ	0.61 UJ	0.58 U	0.58 UJ
IRON, TOTAL	MG/KG	19200 J	24800 J	20100 J	20700	17900	21700 J	15800 J	30700 J	21500	15500 J
LEAD, TOTAL	MG/KG	33.9	12.9	17.7	18.5	22.7	16.8	910	54.7	4180	37.2
MAGNESIUM, TOTAL	MG/KG	707 J	607 J	744 J	1480 J	984 J	548	10700	1710	7060 J	1160
MANGANESE, TOTAL	MG/KG	726 J	582 J	1770 J	296 J	273 J	140 J	530 J	936 J	6340 J	436 J
MERCURY, TOTAL	MG/KG	0.12 U	0.13 U	0.12 U	0.12 U	0.12 U	0.12 U	0.97 J	0.12 U	1.7	0.12 U
NICKEL, TOTAL	MG/KG	10.5 J	6.8 J	20.3 J	8.4	6.7	6.8	15.2	31.4	32.2	10.9
POTASSIUM, TOTAL	MG/KG	359 UJ	375 UJ	350 UJ	374 U	367 U	380	841	1140	550	519
SELENIUM, TOTAL	MG/KG	0.24 UJ	0.25 UJ	0.23 UJ	0.25 UR	0.24 UR	0.23 UR	1.2 UR	0.25 UR	1.2 UR	0.23 UR
SILVER, TOTAL	MG/KG	1.2 UJ	1.5 J	1.3 J	1.4	1.3	1.2 U	1.5	1.2 U	3.3	1.2 U
SODIUM, TOTAL	MG/KG	95.8 UJ	100 UJ	93.2 UJ	190	190	92.5 U	137	215	700	93.1 U
THALLIUM, TOTAL	MG/KG	0.24 UJ	0.25 UJ	0.23 UJ	0.25 U	0.24 U	0.23 U	0.28	0.25 U	0.24 U	0.23 UJ
VANADIUM, TOTAL	MG/KG	19.8 J	18.2 J	17.9 J	14	12.4	18.9	13.9	16.7	9.2	13.5
ZINC, TOTAL	MG/KG	41.8 J	26.6 J	53.5 J	122	83.1	33.7	174	297	24800	58.7
PCBs											
PCB-1016	UG/KG	40 U	41 U	39 U	41 U	40 U			41 U		
PCB-1221	UG/KG	80 U	84 U	78 U	83 U	82 U			83 U		
PCB-1232	UG/KG	40 U	41 U	39 U	41 U	40 U			41 U		
PCB-1242	UG/KG	40 U	41 U	39 U	41 U	40 U			41 U		
PCB-1248	UG/KG	40 U	41 U	39 U	41 U	40 U			41 U		
PCB-1254	UG/KG	40 U	41 U	39 U	41 U	40 U			41 U		
PCB-1260	UG/KG	40 U	41 U	39 U	41 U	40 U			41 U		
PESTICIDES											
4,4'-DDD	UG/KG	4 U	4.1 U	3.8 U	4.1 U	4 U			4.1 U		
4,4'-DDE	UG/KG	4 U	4.1 U	3.8 U	4.1 U	4 U			4.1 U		

TABLE C-1.a.1
ABG SURFACE/SUBSURFACE SOIL SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME ANALYTES	UNITS	030101 Surface	030201 Surface	030301 Surface	030401 Surface	030401, D Surface	030501 Surface	030601 Surface	030701 Surface	031201 Surface	031301 Surface
PESTICIDES, cont.											
4,4'-DDT	UG/KG	4 U	4.1 U	3.8 U	4.1 U	4 U			4.1 U		
A-ENDOSULFAN	UG/KG	2 U	2.1 U	2 U	2.1 U	2.1 U			2.1 U		
ALDRIN	UG/KG	2 U	2.1 U	2 U	2.1 U	2.1 U			2.1 U		
ALPHA-BHC	UG/KG	2 U	2.1 U	2 U	2.1 U	2.1 U			2.1 U		
ALPHA-CHLORDANE	UG/KG	2 U	2.1 U	2 U	2.1 U	2.1 U			2.1 U		
B-ENDOSULFAN	UG/KG	4 U	4.1 U	3.8 U	4.1 U	4 U			4.1 U		
BETA-BHC	UG/KG	2 U	2.1 U	2 U	2.1 U	2.1 U			2.1 U		
DELTA-BHC	UG/KG	2 U	2.1 U	2 U	2.1 U	2.1 U			2.1 U		
DIELDRIN	UG/KG	4 U	4.1 U	3.8 U	4.1 U	4 U			4.1 U		
ENDOSULFAN SULFATE	UG/KG	4 U	4.1 U	3.8 U	4.1 U	4 U			4.1 U		
ENDRIN	UG/KG	4 U	4.1 U	3.8 U	4.1 U	4 U			4.1 U		
ENDRIN ALDEHYDE	UG/KG	4 U	4.1 U	3.8 U	4.1 U	4 U			4.1 U		
ENDRIN KETONE	UG/KG	4 U	4.1 U	3.8 U	4.1 U	4 U			4.1 U		
GAMMA-BHC (LINDANE)	UG/KG	2 U	2.1 U	2 U	2.1 U	2.1 U			2.1 U		
GAMMA-CHLORDANE	UG/KG	2 U	2.1 U	2 U	2.1 U	2.1 U			2.1 U		
HEPTACHLOR	UG/KG	2 U	2.1 U	2 U	2.1 U	2.1 U			2.1 U		
HEPTACHLOR EPOXIDE	UG/KG	2 U	2.1 U	2 U	2.1 U	2.1 U			2.1 U		
METHOXYCHLOR	UG/KG	20 U	21 U	20 U	21 U	21 U			21 U		
TOXAPHENE	UG/KG	200 U	210 U	200 U	210 U	210 U			210 U		
SVOCs											
1,2-DICHLOROBENZENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
1,2,4-TRICHLOROBENZENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
1,3-DICHLOROBENZENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
1,4-DICHLOROBENZENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
2-CHLORONAPHTHALENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
2-CHLOROPHENOL	UG/KG	400 U		390 U	410 U	400 U			410 U		
2-METHYL-4,6-DINITROPHENOL	UG/KG	990 U		970 U	1000 U	1000 U			1000 U		
2-METHYLNAPHTHALENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
2-METHYLPHENOL (O-CRESOL)	UG/KG	400 U		390 U	410 U	400 U			410 U		
2-NITROANILINE	UG/KG	990 U		970 U	1000 U	1000 U			1000 U		
2-NITROPHENOL	UG/KG	400 U		390 U	410 U	400 U			410 U		
2,4-DICHLOROPHENOL	UG/KG	400 U		390 U	410 U	400 U			410 U		
2,4-DIMETHYLPHENOL	UG/KG	400 U		390 U	410 U	400 U			410 U		
2,4-DINITROPHENOL	UG/KG	990 U		970 U	1000 U	1000 U			1000 U		
2,4,5-TRICHLOROPHENOL	UG/KG	990 U		970 U	1000 U	1000 U			1000 U		
2,4,6-TRICHLOROPHENOL	UG/KG	400 U		390 U	410 U	400 U			410 U		
3-NITROANILINE	UG/KG	990 U		970 U	1000 U	1000 U			1000 U		
3,3'-DICHLOROBENZIDINE	UG/KG	400 U		390 U	410 U	400 U			410 U		
4-BROMOPHENYL PHENYL ETHER	UG/KG	400 U		390 U	410 U	400 U			410 U		

TABLE C-1.a
ABG SURFACE/[illegible]FACE SOIL SAMPLE RESULTS
1997 SOUTHWEST[illegible]
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		030101	030201	030301	030401	030401, D	030501	030601	030701	031201	031301
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
SVOCs, cont.											
4-CHLORO-3-METHYLPHENOL	UG/KG	400 U		390 U	410 U	400 U			410 U		
4-CHLOROANILINE	UG/KG	400 U		390 U	410 U	400 U			410 U		
4-CHLOROPHENYL PHENYL ETHER	UG/KG	400 U		390 U	410 U	400 U			410 U		
4-METHYLPHENOL (P-CRESOL)	UG/KG	400 U		390 U	410 U	400 U			410 U		
4-NITROANILINE	UG/KG	990 U		970 U	1000 U	1000 U			1000 U		
4-NITROPHENOL	UG/KG	990 U		970 U	1000 U	1000 U			1000 U		
ACENAPHTHENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
ACENAPHTHYLENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
ANTHRACENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
BENZO(A)ANTHRACENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
BENZO(A)PYRENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
BENZO(B)FLUORANTHENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
BENZO(G,H,I)PERYLENE	UG/KG	400 U		390 U	410 U	400 U			410 UJ		
BENZO(K)FLUORANTHENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
BIS(2-CHLOROETHOXY)METHANE	UG/KG	400 U		390 U	410 U	400 U			410 U		
BIS(2-CHLOROETHYL) ETHER	UG/KG	400 U		390 U	410 U	400 U			410 U		
BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	400 U		390 U	410 U	400 U			410 U		
BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	400 U		390 U	410 U	400 U			410 U		
BUTYLBENZYLPHTHALATE	UG/KG	400 U		390 U	410 U	400 U			410 U		
CARBAZOLE	UG/KG	400 U		390 U	410 U	400 U			410 U		
CHRYSENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
DIBENZOFURAN	UG/KG	400 U		390 U	410 U	400 U			410 U		
DIBENZO(A,H)ANTHRACENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
DIETHYL PHTHALATE	UG/KG	400 U		390 U	410 U	400 U			410 U		
DIMETHYL PHTHALATE	UG/KG	400 U		390 U	410 U	400 U			410 U		
DI-N-BUTYL PHTHALATE	UG/KG	140 J		83 J	71 J	110 J			30 J		
DI-N-OCTYL PHTHALATE	UG/KG	400 U		390 U	410 U	400 U			410 U		
FLUORANTHENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
FLUORENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
HEXACHLOROBENZENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
HEXACHLOROBUTADIENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
HEXACHLOROCYCLOPENTADIENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
HEXACHLOROETHANE	UG/KG	400 U		390 U	410 U	400 U			410 U		
INDENO(1,2,3-CD)PYRENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
ISOPHORONE	UG/KG	400 U		390 U	410 U	400 U			410 U		
NAPHTHALENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
N-NITROSO-DI-N-PROPYLAMINE	UG/KG	400 U		390 U	410 U	400 U			410 U		
N-NITROSODIPHENYLAMINE	UG/KG	400 U		390 U	410 U	400 U			410 U		
PENTACHLOROPHENOL	UG/KG	990 U		970 U	1000 U	1000 U			1000 U		

TABLE C-1.a.1
ABG SURFACE/SUBSURFACE SOIL SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME ANALYTES	UNITS	030101 Surface	030201 Surface	030301 Surface	030401 Surface	030401, D Surface	030501 Surface	030601 Surface	030701 Surface	031201 Surface	031301 Surface
SVOCs, cont.											
PHENANTHRENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
PHENOL	UG/KG	400 U		390 U	410 U	400 U			410 U		
PYRENE	UG/KG	400 U		390 U	410 U	400 U			410 U		
VOCs											
1,1-DICHLOROETHANE	UG/KG	12 U		12 U	13 UJ	12 UJ			12 U		
1,1-DICHLOROETHENE	UG/KG	12 U		12 U	13 U	12 U			12 U		
1,1,1-TRICHLOROETHANE	UG/KG	12 U		12 U	13 U	12 U			12 U		
1,1,2-TRICHLOROETHANE	UG/KG	12 U		12 U	13 U	12 U			12 U		
1,1,2,2-TETRACHLOROETHANE	UG/KG	12 U		12 U	13 U	12 U			12 U		
1,2-DICHLOROETHANE	UG/KG	12 U		12 U	13 UJ	12 UJ			12 U		
1,2-DICHLOROETHENE(TOTAL)	UG/KG	12 U		12 U	13 U	12 U			12 U		
1,2-DICHLOROPROPANE	UG/KG	12 U		12 U	13 UJ	12 UJ			12 U		
2-BUTANONE (MEK)	UG/KG	12 U		12 U	13 U	12 U			12 UJ		
2-HEXANONE	UG/KG	12 UJ		12 UJ	13 U	12 U			12 UJ		
4-METHYL-2-PENTANONE (MIBK)	UG/KG	12 U		12 U	13 U	12 U			12 UJ		
ACETONE	UG/KG	33 JU		28 UJ	16 BJU	26 BJU			12 UJ		
BENZENE	UG/KG	12 U		12 U	13 U	12 U			12 U		
BROMODICHLOROMETHANE	UG/KG	12 U		12 U	13 U	12 U			12 U		
BROMOFORM	UG/KG	12 U		12 U	13 U	12 U			12 U		
BROMOMETHANE (METHYL BROMIDE)	UG/KG	12 U		12 U	13 U	12 U			12 U		
CARBON DISULFIDE	UG/KG	12 UJ		12 UJ	13 U	12 U			12 U		
CARBON TETRACHLORIDE	UG/KG	12 U		12 U	13 U	12 U			12 U		
CHLOROBENZENE	UG/KG	12 U		12 U	13 U	12 U			12 U		
CHLOROETHANE	UG/KG	12 U		12 U	13 U	12 U			12 UJ		
CHLOROFORM	UG/KG	12 U		12 U	13 U	12 U			12 U		
CHLOROMETHANE (METHYL CHLORIDE)	UG/KG	12 U		12 U	13 U	12 U			12 UJ		
CIS-1,3-DICHLOROPROPENE	UG/KG	12 U		12 U	13 U	12 U			12 U		
DIBROMOCHLOROMETHANE	UG/KG	12 U		12 U	13 U	12 U			12 U		
ETHYLBENZENE	UG/KG	12 U		12 U	13 U	12 U			12 U		
METHYLENE CHLORIDE	UG/KG	12 BU		12 BU	20 BJU	26 BJU			12 U		
STYRENE	UG/KG	12 U		12 U	13 U	12 U			12 U		
TETRACHLOROETHENE	UG/KG	12 U		12 U	13 U	12 U			12 U		
TOLUENE	UG/KG	12 U		12 U	13 U	12 U			12 U		
TRANS-1,3-DICHLOROPROPENE	UG/KG	12 U		12 U	13 U	12 U			12 U		
TRICHLOROETHENE	UG/KG	12 U		12 U	13 U	12 U			12 U		
VINYL CHLORIDE	UG/KG	12 U		12 U	13 U	12 U			12 UJ		
XYLENE, TOTAL	UG/KG	12 U		12 U	13 U	12 U			12 U		
WATER QUALITY PARAMETER											
TOTAL SOLIDS	%	84	80	86	80	82	87	86	81	85	86

TABLE C-1.a
ABG SURFACE [illegible]FACE SOIL SAMPLE RESULTS
1997 SOUTHWEST [illegible]B
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		031401	031701	031901	031901, D	032201	032501	033101	033301	033701	034001
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
EXPLOSIVES											
2,4-DINITROTOLUENE	UG/KG	370 U									
2,6-DINITROTOLUENE	UG/KG	370 U									
NITROBENZENE	UG/KG	370 UJ									
INORGANICS											
ALUMINUM, TOTAL	MG/KG	10600 J	11800 J	4880 J	5790 J	6120 J	6200 J	7220 J	6640 J	5250 J	2490 J
ANTIMONY, TOTAL	MG/KG	9.3 J	5.1 UJ	4.5 UJ	4.5 UJ	5.9 J	10.4 J	31.9 J	7.8 J	7.5 J	5.6 J
ARSENIC, TOTAL	MG/KG	5.8 J	5.8 J	3.6 J	5.2 J	7.8 J	7.8 J	23.3 J	5.9 J	3.2 J	2.4 J
BARIUM, TOTAL	MG/KG	44.6 J	503	126	106	91.3 J	60.4 J	622 J	218 J	458 J	61.8 J
BERYLLIUM, TOTAL	MG/KG	0.43	0.41	0.42	0.46	0.61	0.74	0.35	0.78	0.56	0.22 U
CADMIUM, TOTAL	MG/KG	1.1 U	5.6	1.2	1.7	1.3 U	1.2 U	5.8	1.3 U	3.2	1.1 U
CALCIUM, TOTAL	MG/KG	50600 J	36100	56200	63500	11600 J	4040 J	85400 J	2930 J	4890 J	182000 J
CHROMIUM, TOTAL	MG/KG	11.9	21.7 J	8.2 J	11 J	10.6	13.3	39.8	18.1	14.1	4.9
COBALT, TOTAL	MG/KG	5.2	8.5	9.4	9.5	8.8	19.2	10.5	12.3	7.7	2.9
COPPER, TOTAL	MG/KG	14.4	197	62.1	74.2	53.7	8.8	326	31	309	4.6
CYANIDE	MG/KG	0.56 U	0.63 UJ	0.56 UJ	0.56 UJ	0.63 U	0.58 U	0.59 U	0.62 U	0.58 U	0.53 U
IRON, TOTAL	MG/KG	18400	15700 J	14200 J	18400 J	15500	24800	74600	18900	22600	5690 J
LEAD, TOTAL	MG/KG	21.5	397	119	153	44	20.5	627	32.3	44.7	6
MAGNESIUM, TOTAL	MG/KG	3510 J	6240	4980	3590	1960 J	794 J	8240 J	925 J	3550 J	17000 J
MANGANESE, TOTAL	MG/KG	128 J	890 J	2430 J	669 J	1120 J	717 J	1400 J	1040 J	923 J	199 J
MERCURY, TOTAL	MG/KG	0.11 U	1.9	0.11 U	0.11 U	0.13 U	0.12 U	0.12 U	0.13 U	0.2	0.11 U
NICKEL, TOTAL	MG/KG	11.2	15.3	14.8	14.1	14.1	12.8	32.9	14.1	15.3	8.4
POTASSIUM, TOTAL	MG/KG	346	594	456	624	406	409	3650	643 J	534	332 U
SELENIUM, TOTAL	MG/KG	1.1 UR	1.3 UR	1.1 UR	1.1 UR	1.3 UR	0.23 UR	1.2 UR	0.25 UR	0.24 UR	0.22 UJ
SILVER, TOTAL	MG/KG	2.1	3.6	1.2	1.6	153	1.7	6.9	1.4	1.3	1.1 U
SODIUM, TOTAL	MG/KG	90.4 U	159	196	139	221	93.8 U	360	101 U	96.6	265
THALLIUM, TOTAL	MG/KG	0.23	0.26 J	0.22 UJ	0.23 UJ	0.26 U	0.23 U	0.24 U	0.25 U	0.24 U	0.22 U
VANADIUM, TOTAL	MG/KG	23.9	14.7	12.4	15.5	16.4	15.7	11.6	24.7	12.9	7.1
ZINC, TOTAL	MG/KG	51.7	861	389	361	178	50.2	777	140	259	46
PCBs											
PCB-1016	UG/KG	37 U									
PCB-1221	UG/KG	76 U									
PCB-1232	UG/KG	37 U									
PCB-1242	UG/KG	37 U									
PCB-1248	UG/KG	37 U									
PCB-1254	UG/KG	37 U									
PCB-1260	UG/KG	37 U									
PESTICIDES											
4,4'-DDD	UG/KG	3.7 U									
4,4'-DDE	UG/KG	3.7 U									

TABLE C-1.a.1
ABG SURFACE/SUBSURFACE SOIL SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		031401	031701	031901	031901, D	032201	032501	033101	033301	033701	034001
ANALYTES	UNITS	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
PESTICIDES, cont.											
4,4'-DDT	UG/KG	3.7 U									
A-ENDOSULFAN	UG/KG	1.9 U									
ALDRIN	UG/KG	1.9 U									
ALPHA-BHC	UG/KG	1.9 U									
ALPHA-CHLORDANE	UG/KG	1.9 U									
B-ENDOSULFAN	UG/KG	3.7 U									
BETA-BHC	UG/KG	1.9 U									
DELTA-BHC	UG/KG	1.9 U									
DIELDRIN	UG/KG	3.7 U									
ENDOSULFAN SULFATE	UG/KG	3.7 U									
ENDRIN	UG/KG	3.7 U									
ENDRIN ALDEHYDE	UG/KG	3.7 U									
ENDRIN KETONE	UG/KG	3.7 U									
GAMMA-BHC (LINDANE)	UG/KG	1.9 U									
GAMMA-CHLORDANE	UG/KG	1.9 U									
HEPTACHLOR	UG/KG	1.9 U									
HEPTACHLOR EPOXIDE	UG/KG	1.9 U									
METHOXYCHLOR	UG/KG	19 U									
TOXAPHENE	UG/KG	190 U									
SVOCs											
1,2-DICHLOROBENZENE	UG/KG	370 U									
1,2,4-TRICHLOROBENZENE	UG/KG	370 U									
1,3-DICHLOROBENZENE	UG/KG	370 U									
1,4-DICHLOROBENZENE	UG/KG	370 U									
2-CHLORONAPHTHALENE	UG/KG	370 U									
2-CHLOROPHENOL	UG/KG	370 U									
2-METHYL-4,6-DINITROPHENOL	UG/KG	940 U									
2-METHYLNAPHTHALENE	UG/KG	370 U									
2-METHYLPHENOL (O-CRESOL)	UG/KG	370 U									
2-NITROANILINE	UG/KG	940 U									
2-NITROPHENOL	UG/KG	370 U									
2,4-DICHLOROPHENOL	UG/KG	370 U									
2,4-DIMETHYLPHENOL	UG/KG	370 U									
2,4-DINITROPHENOL	UG/KG	940 U									
2,4,5-TRICHLOROPHENOL	UG/KG	940 U									
2,4,6-TRICHLOROPHENOL	UG/KG	370 U									
3-NITROANILINE	UG/KG	940 U									
3,3'-DICHLOROBENZIDINE	UG/KG	370 U									
4-BROMOPHENYL PHENYL ETHER	UG/KG	370 U									

TABLE C-1.a.
ABG SURFACE [illegible]FACE SOIL SAMPLE RESULTS
1997 SOUTHWE[illegible]
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME ANALYTES	UNITS	031401 Surface	031701 Surface	031901 Surface	031901, D Surface	032201 Surface	032501 Surface	033101 Surface	033301 Surface	033701 Surface	034001 Surface
SVOCs, cont.											
4-CHLORO-3-METHYLPHENOL	UG/KG	370 U									
4-CHLOROANILINE	UG/KG	370 U									
4-CHLOROPHENYL PHENYL ETHER	UG/KG	370 U									
4-METHYLPHENOL (P-CRESOL)	UG/KG	370 U									
4-NITROANILINE	UG/KG	940 U									
4-NITROPHENOL	UG/KG	940 U									
ACENAPHTHENE	UG/KG	370 U									
ACENAPHTHYLENE	UG/KG	370 U									
ANTHRACENE	UG/KG	370 U									
BENZO(A)ANTHRACENE	UG/KG	370 U									
BENZO(A)PYRENE	UG/KG	370 U									
BENZO(B)FLUORANTHENE	UG/KG	370 U									
BENZO(G,H,I)PERYLENE	UG/KG	370 U									
BENZO(K)FLUORANTHENE	UG/KG	370 U									
BIS(2-CHLOROETHOXY)METHANE	UG/KG	370 U									
BIS(2-CHLOROETHYL) ETHER	UG/KG	370 U									
BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	370 U									
BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	370 U									
BUTYLBENZYLPHTHALATE	UG/KG	370 U									
CARBAZOLE	UG/KG	370 U									
CHRYSENE	UG/KG	370 U									
DIBENZOFURAN	UG/KG	370 U									
DIBENZO(A,H)ANTHRACENE	UG/KG	370 U									
DIETHYL PHTHALATE	UG/KG	370 U									
DIMETHYL PHTHALATE	UG/KG	370 U									
DI-N-BUTYL PHTHALATE	UG/KG	95 J									
DI-N-OCTYL PHTHALATE	UG/KG	370 U									
FLUORANTHENE	UG/KG	370 U									
FLUORENE	UG/KG	370 U									
HEXACHLOROBENZENE	UG/KG	370 U									
HEXACHLOROBUTADIENE	UG/KG	370 U									
HEXACHLOROCYCLOPENTADIENE	UG/KG	370 U									
HEXACHLOROETHANE	UG/KG	370 U									
INDENO(1,2,3-CD)PYRENE	UG/KG	370 U									
ISOPHORONE	UG/KG	370 U									
NAPHTHALENE	UG/KG	370 U									
N-NITROSO-DI-N-PROPYLAMINE	UG/KG	370 U									
N-NITROSODIPHENYLAMINE	UG/KG	370 U									
PENTACHLOROPHENOL	UG/KG	940 U									

TABLE C-1.a.1
ABG SURFACE/SUBSURFACE SOIL SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME ANALYTES	UNITS	031401 Surface	031701 Surface	031901 Surface	031901, D Surface	032201 Surface	032501 Surface	033101 Surface	033301 Surface	033701 Surface	034001 Surface
SVOCs, cont.											
PHENANTHRENE	UG/KG	370 U									
PHENOL	UG/KG	370 U									
PYRENE	UG/KG	370 U									
VOCs											
1,1-DICHLOROETHANE	UG/KG	11 UJ	13 U								
1,1-DICHLOROETHENE	UG/KG	11 U	13 U								
1,1,1-TRICHLOROETHANE	UG/KG	11 U	13 U								
1,1,2-TRICHLOROETHANE	UG/KG	11 U	13 U								
1,1,2,2-TETRACHLOROETHANE	UG/KG	11 U	13 U								
1,2-DICHLOROETHANE	UG/KG	11 UJ	13 U								
1,2-DICHLOROETHENE(TOTAL)	UG/KG	11 U	13 U								
1,2-DICHLOROPROPANE	UG/KG	11 UJ	13 U								
2-BUTANONE (MEK)	UG/KG	11 U	13 UJ								
2-HEXANONE	UG/KG	11 U	13 UJ								
4-METHYL-2-PENTANONE (MIBK)	UG/KG	11 U	13 UJ								
ACETONE	UG/KG	15 BJU	13 UJ								
BENZENE	UG/KG	11 U	13 U								
BROMODICHLOROMETHANE	UG/KG	11 U	13 U								
BROMOFORM	UG/KG	11 U	13 U								
BROMOMETHANE (METHYL BROMIDE)	UG/KG	11 U	13 U								
CARBON DISULFIDE	UG/KG	11 U	13 U								
CARBON TETRACHLORIDE	UG/KG	11 U	13 U								
CHLOROBENZENE	UG/KG	11 U	13 U								
CHLOROETHANE	UG/KG	11 U	13 UJ								
CHLOROFORM	UG/KG	11 U	13 U								
CHLOROMETHANE (METHYL CHLORIDE)	UG/KG	11 U	13 UJ								
CIS-1,3-DICHLOROPROPENE	UG/KG	11 U	13 U								
DIBROMOCHLOROMETHANE	UG/KG	11 U	13 U								
ETHYLBENZENE	UG/KG	11 U	13 U								
METHYLENE CHLORIDE	UG/KG	20 BJU	13 UJ								
STYRENE	UG/KG	11 U	13 U								
TETRACHLOROETHENE	UG/KG	11 U	13 U								
TOLUENE	UG/KG	11 U	13 U								
TRANS-1,3-DICHLOROPROPENE	UG/KG	11 U	13 U								
TRICHLOROETHENE	UG/KG	11 U	13 U								
VINYL CHLORIDE	UG/KG	11 U	13 UJ								
XYLENE, TOTAL	UG/KG	11 U	13 U								
WATER QUALITY PARAMETER											
TOTAL SOLIDS	%	89	79	89	88	78	85	84	80	84	90

TABLE C-1.a
ABG SURFACE [illegible]FACE SOIL SAMPLE RESULTS
1997 SOUTHWEST [illegible]B
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		034901	036101	03B701	030404	031203	032205	032205, D	032207
ANALYTES	UNITS	Surface	Surface	Surface	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.
EXPLOSIVES									
2,4-DINITROTOLUENE	UG/KG			390 U	350 U				
2,6-DINITROTOLUENE	UG/KG			390 U	350 U				
NITROBENZENE	UG/KG			390 UJ	350 UJ				
INORGANICS									
ALUMINUM, TOTAL	MG/KG	4370	5720 J	7260 J	4230 J	5290 J	7240 J	8270 J	9550 J
ANTIMONY, TOTAL	MG/KG	4.3 U	10.2 J	4.9 J	6.2 J	11.3 J	11 J	12.5 J	14.7 J
ARSENIC, TOTAL	MG/KG	2.4	3 J	3.7 J	6.9 J	7.6 J	3 J	1.4 J	2.8 J
BARIUM, TOTAL	MG/KG	54.9	60.8 J	47.4 J	140 J	213 J	180 J	280 J	351 J
BERYLLIUM, TOTAL	MG/KG	0.22 U	0.87	0.44	0.46	0.66	0.85	1.2	1.4
CADMIUM, TOTAL	MG/KG	1.1 U	1.2 U	1.2 U	1.1	1.1 U	1.3 U	1.3 U	1.3 U
CALCIUM, TOTAL	MG/KG	85300	320 J	728 J	73800 J	34000 J	127000 J	44300 J	24000 J
CHROMIUM, TOTAL	MG/KG	4.6	12.7	8.8	9.6	12.7	9.5	10.8	13
COBALT, TOTAL	MG/KG	2.7 B	22.1	7.4	7.6	9.7	7.5	8.8	12.8
COPPER, TOTAL	MG/KG	16.5	13.7	6.4	98.2	116	19.6	24.1	26.2
CYANIDE	MG/KG	0.54 UJ	0.58 U	0.58 U	0.54 U	0.56 U	0.64 U	0.66 U	0.66 U
IRON, TOTAL	MG/KG	6310	29200 J	12700 J	17500	20600	23000	31600	36700
LEAD, TOTAL	MG/KG	1780	9.6	7.5	188	107 J	14.7	9	13.1
MAGNESIUM, TOTAL	MG/KG	10900	1410	738 J	10500 J	2880 J	1990 J	1750 J	1870 J
MANGANESE, TOTAL	MG/KG	242	338 J	316 J	468 J	847 J	1530 J	2980 J	3990 J
MERCURY, TOTAL	MG/KG	0.11 U	0.12 U	0.12 U	0.15	0.11 U	0.13 U	0.13 U	0.13 U
NICKEL, TOTAL	MG/KG	7.4 B	33.1	10.4	11.5	21.7	21.5	32.9	46
POTASSIUM, TOTAL	MG/KG	451 B	807	358 U	381	1390	722	642	1070
SELENIUM, TOTAL	MG/KG	1.1 U	0.24 UJ	0.24 UJ	1.1 UR	1.1 UR	1.3 UR	1.3 UR	1.3 UR
SILVER, TOTAL	MG/KG	1.3 B	1.6	1.2 U	2.1	1.5	1.4	2	2
SODIUM, TOTAL	MG/KG	173 B	96.4	95.5 U	171	190	236	239	272
THALLIUM, TOTAL	MG/KG	0.22 U	0.24 U	0.24 U	0.21 U	0.22 U	0.26 U	0.27 U	0.27 U
VANADIUM, TOTAL	MG/KG	6.2 B	16.6	16.1	12.5	13.1	11.4	14	15
ZINC, TOTAL	MG/KG	90.9	88	31.5	220	1160	33	43.9	46.1
PCBs									
PCB-1016	UG/KG			39 U	35 U				
PCB-1221	UG/KG			80 U	72 U				
PCB-1232	UG/KG			39 U	35 U				
PCB-1242	UG/KG			39 U	35 U				
PCB-1248	UG/KG			39 U	35 U				
PCB-1254	UG/KG			39 U	35 U				
PCB-1260	UG/KG			39 U	35 U				
PESTICIDES									
4,4'-DDD	UG/KG			3.9 U	3.5 U				
4,4'-DDE	UG/KG			3.9 U	3.5 U				

TABLE C-1.a.1
ABG SURFACE/SUBSURFACE SOIL SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		034901	036101	03B701	030404	031203	032205	032205, D	032207
ANALYTES	UNITS	Surface	Surface	Surface	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.
PESTICIDES, cont.									
4,4'-DDT	UG/KG			3.9 U	3.5 U				
A-ENDOSULFAN	UG/KG			2 U	1.8 U				
ALDRIN	UG/KG			2 U	1.8 U				
ALPHA-BHC	UG/KG			2 U	1.8 U				
ALPHA-CHLORDANE	UG/KG			2 U	1.8 U				
B-ENDOSULFAN	UG/KG			3.9 U	3.5 U				
BETA-BHC	UG/KG			2 U	1.8 U				
DELTA-BHC	UG/KG			2 U	1.8 U				
DIELDRIN	UG/KG			3.9 U	3.5 U				
ENDOSULFAN SULFATE	UG/KG			3.9 U	3.5 U				
ENDRIN	UG/KG			3.9 U	3.5 U				
ENDRIN ALDEHYDE	UG/KG			3.9 U	3.5 U				
ENDRIN KETONE	UG/KG			3.9 U	3.5 U				
GAMMA-BHC (LINDANE)	UG/KG			2 U	1.8 U				
GAMMA-CHLORDANE	UG/KG			2 U	1.8 U				
HEPTACHLOR	UG/KG			2 U	1.8 U				
HEPTACHLOR EPOXIDE	UG/KG			2 U	1.8 U				
METHOXYCHLOR	UG/KG			20 U	18 U				
TOXAPHENE	UG/KG			200 U	180 U				
SVOCs									
1,2-DICHLOROBENZENE	UG/KG			390 U	350 U				
1,2,4-TRICHLOROBENZENE	UG/KG			390 U	350 U				
1,3-DICHLOROBENZENE	UG/KG			390 U	350 U				
1,4-DICHLOROBENZENE	UG/KG			390 U	350 U				
2-CHLORONAPHTHALENE	UG/KG			390 U	350 U				
2-CHLOROPHENOL	UG/KG			390 U	350 U				
2-METHYL-4,6-DINITROPHENOL	UG/KG			990 U	890 U				
2-METHYLNAPHTHALENE	UG/KG			390 U	350 U				
2-METHYLPHENOL (O-CRESOL)	UG/KG			390 U	350 U				
2-NITROANILINE	UG/KG			990 U	890 U				
2-NITROPHENOL	UG/KG			390 U	350 U				
2,4-DICHLOROPHENOL	UG/KG			390 U	350 U				
2,4-DIMETHYLPHENOL	UG/KG			390 U	350 U				
2,4-DINITROPHENOL	UG/KG			990 U	890 U				
2,4,5-TRICHLOROPHENOL	UG/KG			990 U	890 U				
2,4,6-TRICHLOROPHENOL	UG/KG			390 U	350 U				
3-NITROANILINE	UG/KG			990 U	890 U				
3,3'-DICHLOROBENZIDINE	UG/KG			390 U	350 U				
4-BROMOPHENYL PHENYL ETHER	UG/KG			390 U	350 U				

TABLE C-1.a
ABG SURFACE [illegible]RFACE SOIL SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		034901	036101	03B701	030404	031203	032205	032205, D	032207
ANALYTES	UNITS	Surface	Surface	Surface	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.
SVOCs, cont.									
4-CHLORO-3-METHYLPHENOL	UG/KG			390 U	350 U				
4-CHLOROANILINE	UG/KG			390 U	350 U				
4-CHLOROPHENYL PHENYL ETHER	UG/KG			390 U	350 U				
4-METHYLPHENOL (P-CRESOL)	UG/KG			390 U	350 U				
4-NITROANILINE	UG/KG			990 U	890 U				
4-NITROPHENOL	UG/KG			990 U	890 U				
ACENAPHTHENE	UG/KG			390 U	350 U				
ACENAPHTHYLENE	UG/KG			390 U	350 U				
ANTHRACENE	UG/KG			390 U	350 U				
BENZO(A)ANTHRACENE	UG/KG			390 U	350 U				
BENZO(A)PYRENE	UG/KG			390 U	350 U				
BENZO(B)FLUORANTHENE	UG/KG			390 U	350 U				
BENZO(G,H,I)PERYLENE	UG/KG			390 U	350 U				
BENZO(K)FLUORANTHENE	UG/KG			390 U	350 U				
BIS(2-CHLOROETHOXY)METHANE	UG/KG			390 U	350 U				
BIS(2-CHLOROETHYL) ETHER	UG/KG			390 U	350 U				
BIS(2-CHLOROISOPROPYL) ETHER	UG/KG			390 U	350 U				
BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG			390 U	280 J				
BUTYLBENZYLPHTHALATE	UG/KG			390 U	350 U				
CARBAZOLE	UG/KG			390 U	350 U				
CHRYSENE	UG/KG			390 U	350 U				
DIBENZOFURAN	UG/KG			390 U	350 U				
DIBENZO(A,H)ANTHRACENE	UG/KG			390 U	350 U				
DIETHYL PHTHALATE	UG/KG			390 U	350 U				
DIMETHYL PHTHALATE	UG/KG			390 U	350 U				
DI-N-BUTYL PHTHALATE	UG/KG			110 J	180 J				
DI-N-OCTYL PHTHALATE	UG/KG			390 U	350 U				
FLUORANTHENE	UG/KG			390 U	350 U				
FLUORENE	UG/KG			390 U	350 U				
HEXACHLOROBENZENE	UG/KG			390 U	350 U				
HEXACHLOROBUTADIENE	UG/KG			390 U	350 U				
HEXACHLOROCYCLOPENTADIENE	UG/KG			390 U	350 U				
HEXACHLOROETHANE	UG/KG			390 U	350 U				
INDENO(1,2,3-CD)PYRENE	UG/KG			390 U	350 U				
ISOPHORONE	UG/KG			390 U	350 U				
NAPHTHALENE	UG/KG			390 U	350 U				
N-NITROSO-DI-N-PROPYLAMINE	UG/KG			390 U	350 U				
N-NITROSODIPHENYLAMINE	UG/KG			390 U	350 U				
PENTACHLOROPHENOL	UG/KG			990 U	890 U				

TABLE C-1.a.1
ABG SURFACE/SUBSURFACE SOIL SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		034901	036101	03B701	030404	031203	032205	032205, D	032207
ANALYTES	UNITS	Surface	Surface	Surface	Subsurf.	Subsurf.	Subsurf.	Subsurf.	Subsurf.
SVOCs, cont.									
PHENANTHRENE	UG/KG			390 U	350 U				
PHENOL	UG/KG			390 U	350 U				
PYRENE	UG/KG			390 U	350 U				
VOCs									
1,1-DICHLOROETHANE	UG/KG			12 U	11 U				
1,1-DICHLOROETHENE	UG/KG			12 U	11 U				
1,1,1-TRICHLOROETHANE	UG/KG			12 U	11 U				
1,1,2-TRICHLOROETHANE	UG/KG			12 U	11 U				
1,1,2,2-TETRACHLOROETHANE	UG/KG			12 U	11 U				
1,2-DICHLOROETHANE	UG/KG			12 U	11 U				
1,2-DICHLOROETHENE(TOTAL)	UG/KG			12 U	11 U				
1,2-DICHLOROPROPANE	UG/KG			12 U	11 U				
2-BUTANONE (MEK)	UG/KG			12 U	11 U				
2-HEXANONE	UG/KG			12 U	11 UJ				
4-METHYL-2-PENTANONE (MIBK)	UG/KG			12 U	11 U				
ACETONE	UG/KG			11 BJU	28 J				
BENZENE	UG/KG			12 U	11 U				
BROMODICHLOROMETHANE	UG/KG			12 U	11 U				
BROMOFORM	UG/KG			12 U	11 U				
BROMOMETHANE (METHYL BROMIDE)	UG/KG			12 U	11 U				
CARBON DISULFIDE	UG/KG			12 U	11 UJ				
CARBON TETRACHLORIDE	UG/KG			12 U	11 U				
CHLOROBENZENE	UG/KG			12 U	11 U				
CHLOROETHANE	UG/KG			12 U	11 U				
CHLOROFORM	UG/KG			12 U	11 U				
CHLOROMETHANE (METHYL CHLORIDE)	UG/KG			12 U	11 U				
CIS-1,3-DICHLOROPROPENE	UG/KG			12 U	11 U				
DIBROMOCHLOROMETHANE	UG/KG			12 U	11 U				
ETHYLBENZENE	UG/KG			12 U	11 U				
METHYLENE CHLORIDE	UG/KG			17 BU	11 BU				
STYRENE	UG/KG			12 U	11 U				
TETRACHLOROETHENE	UG/KG			12 U	11 U				
TOLUENE	UG/KG			12 U	11 U				
TRANS-1,3-DICHLOROPROPENE	UG/KG			12 U	11 U				
TRICHLOROETHENE	UG/KG			12 U	11 U				
VINYL CHLORIDE	UG/KG			12 U	11 U				
XYLENE, TOTAL	UG/KG			12 U	11 U				
WATER QUALITY PARAMETER									
TOTAL SOLIDS	%	93	85	84	93	89	77	75	75

T[illegible]-1.c.1a
A[illegible]ACE WATER SAMPLE RESULTS
199[illegible]UTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME	UNITS	SW03BG05,D	SW03BG05	SW03BG06	SW03BG11	SW03BG08
ANALYTES						
EXPLOSIVES						
2,4-DINITROTOLUENE	UG/L				5 UJ	5 UJ
2,6-DINITROTOLUENE	UG/L				5 U	5 U
NITROBENZENE	UG/L				5 U	5 U
INORGANICS						
ALUMINUM, TOTAL	UG/L	50 UJ	50 UJ	1610 J	50 UJ	2210 J
ANTIMONY, TOTAL	UG/L	8 UJ	8 UJ	8 UR	8 UJ	8 UR
ARSENIC, TOTAL	UG/L	1 UJ	1 UJ	1.9 J	1 UJ	3.1 J
BARIUM, TOTAL	UG/L	225 J	222 J	115	120 J	122
BERYLLIUM, TOTAL	UG/L	1 UJ	1 UJ	1 U	1 UJ	1 U
CADMIUM, TOTAL	UG/L	2 UJ	2 UJ	2 U	2 UJ	2.2
CALCIUM, TOTAL	UG/L	57400 J	56400 J	26800	44900 J	30900
CHROMIUM, TOTAL	UG/L	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ
COBALT, TOTAL	UG/L	5 UJ	5 UJ	5 U	5 UJ	5 U
COPPER, TOTAL	UG/L	5 UJ	5 UJ	7.7	5 UJ	29.2
CYANIDE	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U
IRON, TOTAL	UG/L	187 J	194 J	3030	101 J	3730
LEAD, TOTAL	UG/L	3.7 J	4.5 J	67 J	1.3 J	130
MAGNESIUM, TOTAL	UG/L	11900 J	11700 J	5760	9000 J	5120
MANGANESE, TOTAL	UG/L	218 J	217 J	50.8	32.6 J	117
MERCURY, TOTAL	UG/L	0.2 UJ	0.2 UJ	0.2 U	0.2 UJ	0.2 U
NICKEL, TOTAL	UG/L	20 UJ	20 UJ	20 U	20 UJ	20 U
POTASSIUM, TOTAL	UG/L	8520 J	7910 J	7870 J	1560 J	8220 J
SELENIUM, TOTAL	UG/L	1 UJ	1 UJ	1 UR	1 UJ	1 UR
SILVER, TOTAL	UG/L	5 UJ	5 UJ	5 U	5 UJ	5 U
SODIUM, TOTAL	UG/L	7210 J	7140 J	4680	5780 J	4290
THALLIUM, TOTAL	UG/L	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
VANADIUM, TOTAL	UG/L	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ
ZINC, TOTAL	UG/L	5 UJ	5 UJ	95.2 J	5 UJ	200 J
PCBs						
PCB-1016	UG/L			0.2 U	0.2 U	0.2 U
PCB-1221	UG/L			0.4 U	0.4 U	0.4 U
PCB-1232	UG/L			0.2 U	0.2 U	0.2 U
PCB-1242	UG/L			0.2 U	0.2 U	0.2 U
PCB-1248	UG/L			0.2 U	0.2 U	0.2 U
PCB-1254	UG/L			0.2 U	0.2 U	0.2 U
PCB-1260	UG/L			0.2 U	0.2 U	0.2 U
PESTICIDES						
4,4'-DDD	UG/L			0.02 U	0.02 U	0.02 U
4,4'-DDE	UG/L			0.02 U	0.02 U	0.02 U

TABLE C-1.c.1a
ABG SURFACE WATER SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME	UNITS	SW03BG05,D	SW03BG05	SW03BG06	SW03BG11	SW03BG08
ANALYTES						
PESTICIDES, cont.						
4,4'-DDT	UG/L			0.02 U	0.02 U	0.02 U
A-ENDOSULFAN	UG/L			0.01 U	0.01 U	0.01 U
ALDRIN	UG/L			0.01 U	0.01 U	0.01 U
ALPHA-BHC	UG/L			0.01 U	0.01 U	0.01 U
ALPHA-CHLORDANE	UG/L			0.01 U	0.01 U	0.01 U
B-ENDOSULFAN	UG/L			0.02 U	0.02 U	0.02 U
BETA-BHC	UG/L			0.01 U	0.01 U	0.01 U
DELTA-BHC	UG/L			0.01 U	0.01 U	0.01 U
DIELDRIN	UG/L			0.02 U	0.02 U	0.02 U
ENDOSULFAN SULFATE	UG/L			0.02 U	0.02 U	0.02 U
ENDRIN	UG/L			0.02 U	0.02 U	0.02 U
ENDRIN ALDEHYDE	UG/L			0.02 U	0.02 U	0.02 U
ENDRIN KETONE	UG/L			0.02 U	0.02 U	0.02 U
GAMMA-BHC (LINDANE)	UG/L			0.01 U	0.01 U	0.01 U
GAMMA-CHLORDANE	UG/L			0.01 U	0.01 U	0.01 U
HEPTACHLOR	UG/L			0.01 U	0.01 U	0.01 U
HEPTACHLOR EPOXIDE	UG/L			0.01 U	0.01 U	0.01 U
METHOXYCHLOR	UG/L			0.1 U	0.1 U	0.1 U
TOXAPHENE	UG/L			1 U	1 U	1 U
SVOCs						
1,2-DICHLOROBENZENE	UG/L				1 U	1 U
1,2,4-TRICHLOROBENZENE	UG/L				5 U	5 U
1,3-DICHLOROBENZENE	UG/L				1 U	1 U
1,4-DICHLOROBENZENE	UG/L				1 U	1 U
2-CHLORONAPHTHALENE	UG/L				5 U	5 U
2-CHLOROPHENOL	UG/L				5 U	5 U
2-METHYL-4,6-DINITROPHENOL	UG/L				20 U	20 U
2-METHYLNAPHTHALENE	UG/L				5 U	5 U
2-METHYLPHENOL (O-CRESOL)	UG/L				5 U	5 U
2-NITROANILINE	UG/L				20 U	20 U
2-NITROPHENOL	UG/L				5 U	5 U
2,4-DICHLOROPHENOL	UG/L				5 UJ	5 UJ
2,4-DIMETHYLPHENOL	UG/L				5 U	5 U
2,4-DINITROPHENOL	UG/L				20 UJ	20 UJ
2,4,5-TRICHLOROPHENOL	UG/L				20 U	20 U
2,4,6-TRICHLOROPHENOL	UG/L				5 U	5 U
3-NITROANILINE	UG/L				20 U	20 U
3,3'-DICHLOROBENZIDINE	UG/L				5 UJ	5 UJ
4-BROMOPHENYL PHENYL ETHER	UG/L				5 U	5 U

TABLE C-1.c.1a
AREA SURFACE WATER SAMPLE RESULTS
1994 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME	UNITS	SW03BG05,D	SW03BG05	SW03BG06	SW03BG11	SW03BG08
ANALYTES						
SVOCs, cont.						
4-CHLORO-3-METHYLPHENOL	UG/L				5 U	5 U
4-CHLOROANILINE	UG/L				5 U	5 U
4-CHLOROPHENYL PHENYL ETHER	UG/L				5 U	5 U
4-METHYLPHENOL (P-CRESOL)	UG/L				5 U	5 U
4-NITROANILINE	UG/L				20 UJ	20 UJ
4-NITROPHENOL	UG/L				20 U	20 U
ACENAPHTHENE	UG/L				5 U	5 U
ACENAPHTHYLENE	UG/L				5 U	5 U
ANTHRACENE	UG/L				5 U	5 U
BENZO(A)ANTHRACENE	UG/L				5 U	5 U
BENZO(A)PYRENE	UG/L				5 U	5 U
BENZO(B)FLUORANTHENE	UG/L				5 U	5 U
BENZO(G,H,I)PERYLENE	UG/L				5 U	5 U
BENZO(K)FLUORANTHENE	UG/L				5 U	5 U
BIS(2-CHLOROETHOXY)METHANE	UG/L				5 U	5 U
BIS(2-CHLOROETHYL) ETHER	UG/L				5 U	5 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/L				5 U	5 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L				5 U	5 U
BUTYLBENZYLPHTHALATE	UG/L				5 U	5 U
CHRYSENE	UG/L				5 U	5 U
DIBENZOFURAN	UG/L				5 U	5 U
DIBENZO(A,H)ANTHRACENE	UG/L				5 U	5 U
DIETHYL PHTHALATE	UG/L				5 U	5 U
DIMETHYL PHTHALATE	UG/L				5 U	5 U
DI-N-BUTYL PHTHALATE	UG/L				5 BU	1.1 J
DI-N-OCTYL PHTHALATE	UG/L				5 U	5 U
FLUORANTHENE	UG/L				5 U	5 U
FLUORENE	UG/L				5 U	5 U
HEXACHLOROBENZENE	UG/L				5 U	5 U
HEXACHLOROBUTADIENE	UG/L				5 U	5 U
HEXACHLOROCYCLOPENTADIENE	UG/L				5 UJ	5 UJ
HEXACHLOROETHANE	UG/L				5 U	5 U
INDENO(1,2,3-CD)PYRENE	UG/L				5 U	5 U
ISOPHORONE	UG/L				5 U	5 U
NAPHTHALENE	UG/L				5 U	5 U
N-NITROSO-DI-N-PROPYLAMINE	UG/L				5 U	5 U
N-NITROSODIPHENYLAMINE	UG/L				5 U	5 U
PENTACHLOROPHENOL	UG/L				20 U	20 U
PHENANTHRENE	UG/L				5 U	5 U

TABLE C-1.c.1a
ABG SURFACE WATER SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME	UNITS	SW03BG05,D	SW03BG05	SW03BG06	SW03BG11	SW03BG08
ANALYTES						
SVOCs, cont.						
PHENOL	UG/L				5 U	5 U
PYRENE	UG/L				5 U	5 U
VOCs						
1,1-DICHLOROETHANE	UG/L				1 U	1 U
1,1-DICHLOROETHENE	UG/L				1 U	1 U
1,1,1-TRICHLOROETHANE	UG/L				1 U	1 U
1,1,2-TRICHLOROETHANE	UG/L				1 U	1 U
1,1,2,2-TETRACHLOROETHANE	UG/L				1 U	1 U
1,2-DIBROMO-3-CHLOROPROPANE	UG/L				1 UR	1 UR
1,2-DIBROMOETHANE	UG/L				1 U	1 U
1,2-DICHLOROETHANE	UG/L				1 U	1 U
1,2-DICHLOROPROPANE	UG/L				1 U	1 U
2-BUTANONE (MEK)	UG/L				5 UR	5 UR
2-HEXANONE	UG/L				5 U	5 U
4-METHYL-2-PENTANONE (MIBK)	UG/L				5 U	5 U
ACETONE	UG/L				5 UR	5 UR
BENZENE	UG/L				1 U	1 U
BROMOCHLOROMETHANE	UG/L				1 U	1 U
BROMODICHLOROMETHANE	UG/L				1 U	1 U
BROMOFORM	UG/L				1 U	1 U
BROMOMETHANE (METHYL BROMIDE)	UG/L				1 U	1 U
CARBON DISULFIDE	UG/L				1 U	1 U
CARBON TETRACHLORIDE	UG/L				1 U	1 U
CHLOROBENZENE	UG/L				1 U	1 U
CHLOROETHANE	UG/L				1 U	1 U
CHLOROFORM	UG/L				1 U	1 U
CHLOROMETHANE (METHYL CHLORIDE)	UG/L				1 U	1 U
CIS-1,2-DICHLOROETHENE	UG/L				1 U	1 U
CIS-1,3-DICHLOROPROPENE	UG/L				1 U	1 U
DIBROMOCHLOROMETHANE	UG/L				1 U	1 U
ETHYLBENZENE	UG/L				1 U	1 U
METHYLENE CHLORIDE	UG/L				13 BJ	3 BU
STYRENE	UG/L				1 U	1 U
TETRACHLOROETHENE	UG/L				1 U	1 U
TOLUENE	UG/L				1 U	1 U
TRANS-1,2-DICHLOROETHENE	UG/L				1 U	1 U
TRANS-1,3-DICHLOROPROPENE	UG/L				1 U	1 U
TRICHLOROETHENE	UG/L				1 U	1 U
VINYL CHLORIDE	UG/L				1 U	1 U

TA[illegible].c.1a
AB[illegible]CE WATER SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME	UNITS	SW03BG05,D	SW03BG05	SW03BG06	SW03BG11	SW03BG08
ANALYTES						
VOCs, cont.						
XYLENE, TOTAL	UG/L				1 U	1 U
WATER QUALITY PARAMETER						
ALKALINITY	MG/L	160	160	73	120	78
CHEMICAL OXYGEN DEMAND	MG/L	5 U	15	28	5 U	9.2
CHLORIDE	MG/L	8.9	8.7	4.7	6.1	5.2
NITROGEN (NO2+NO3)	MG/L	0.56	0.58	1.1	0.6	1.4
PH	PH UN	7.6	7.7	7.8	7.7	7.9
SULFATE	MG/L	47	47	20	39	17
TOTAL DISSOLVED SOLIDS	MG/L	260	260	160	170	160

TABLE C-1.c.1b
ABG SEDIMENT SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME	UNITS	SD03BG05	SD03BG06	SD03BG08,D	SD03BG11	SD03BG08
ANALYTES						
1,3-DINITROBENZENE	UG/KG	900 U	900 U	900 U	900 U	900 U
1,3,5-TRINITROBENZENE	UG/KG	1000 U	1000 U	1000 U	1000 U	1000 U
2-AMINO-4,6-DINITROTOLUENE	UG/KG	900 U	900 U	900 U	900 U	900 U
2,4-DINITROTOLUENE	UG/KG	1000 U	1000 U	1000 U	1000 U	1000 U
2,4-DINITROTOLUENE(2)	UG/KG			380 U	480	380 U
2,4,6-TRINITROTOLUENE (TNT)	UG/KG	1000 U	340 J	1000 U	1000 U	1000 U
2,6-DINITROTOLUENE(2)	UG/KG			380 U	400 U	380 U
2,6-DINITROTOLUENE	UG/KG	900 U	900 U	900 U	900 U	900 U
4-AMINO-2,6-DINITROTOLUENE	UG/KG	900 U	900 U	900 U	900 U	900 U
HMX	UG/KG	300 J	750 J	840 J	900 U	2000
M-NITROTOLUENE	UG/KG	1100 U	1100 U	1100 U	1100 U	1100 U
NITROBENZENE	UG/KG	1000 U	1000 U	1000 U	1000 U	1000 U
NITROBENZENE(2)	UG/KG			380 UJ	400 U	380 UJ
O-NITROTOLUENE	UG/KG	900 U	900 U	900 U	900 U	900 U
P-NITROTOLUENE	UG/KG	900 U	900 U	900 U	900 U	900 U
RDX	UG/KG	900 U	900 U	900 U	900 U	900 U
TETRYL	UG/KG	900 U	900 U	900 U	900 U	900 U
INORGANICS						
ALUMINUM, TOTAL	MG/KG	19600 J	25500 J	7570 J	7130 J	6930 J
ANTIMONY, TOTAL	MG/KG	17.3 J	18.5 J	20.2 J	29.8 J	27.6 J
ARSENIC, TOTAL	MG/KG	6.6 J	19 J	14.1 J	12.5 J	11 J
BARIUM, TOTAL	MG/KG	408 J	2030 J	152 J	67.2 J	242 J
BERYLLIUM, TOTAL	MG/KG	1	1.4	1.1	1.7 J	1.4
CADMIUM, TOTAL	MG/KG	1.4 U	6.1	1.1 U	1.2 UJ	1.2 U
CALCIUM, TOTAL	MG/KG	17700 J	13900 J	5180 J	1140 J	4820 J
CHROMIUM, TOTAL	MG/KG	24	39.8	29.5	47.6 J	40.5
COBALT, TOTAL	MG/KG	15.1	19.2	15	18.8 J	16.6
COPPER, TOTAL	MG/KG	24.7	318	77.6	29.3 J	63.6
CYANIDE	MG/KG	0.63 U	0.52 U	0.56 U	0.53 U	0.58 U
IRON, TOTAL	MG/KG	37400	48000	46400	65400 J	64000
LEAD, TOTAL	MG/KG	123	116	75.1	17.7 J	63.1
MAGNESIUM, TOTAL	MG/KG	3860 J	1440 J	1290 J	373 J	1030 J
MANGANESE, TOTAL	MG/KG	984 J	1280 J	1240 J	1010 J	1140 J
MERCURY, TOTAL	MG/KG	0.14 U	0.16	0.11 U	0.12 U	0.12 U
NICKEL, TOTAL	MG/KG	24.7	31.5	21.2	27.1 J	31.1
POTASSIUM, TOTAL	MG/KG	414 U	353 U	342 U	367 UJ	346 U
SELENIUM, TOTAL	MG/KG	1.4 UR	0.24 UR	0.23 UR	0.24 UJ	1.2 UR
SILVER, TOTAL	MG/KG	2.4	3	2.8	3.8 J	3.8
SODIUM, TOTAL	MG/KG	124	205	91.3 U	97.8 UJ	102
THALLIUM, TOTAL	MG/KG	0.28 U	0.31	0.28	0.32 J	0.23 U

TA[illegible]1.c.1b
AB[illegible]MENT SAMPLE RESULTS
1997 [illegible]OUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME	UNITS	SD03BG05	SD03BG06	SD03BG08,D	SD03BG11	SD03BG08
ANALYTES						
INORGANICS, cont.						
VANADIUM, TOTAL	MG/KG	25.3	35.1	33.6	40 J	36.7
ZINC, TOTAL	MG/KG	99.8	1060	227	105 J	206
PCBs						
PCB-1016	UG/KG		39 U	38 U	40 U	38 U
PCB-1221	UG/KG		79 U	77 U	82 U	77 U
PCB-1232	UG/KG		39 U	38 U	40 U	38 U
PCB-1242	UG/KG		39 U	38 U	40 U	38 U
PCB-1248	UG/KG		39 U	38 U	40 U	38 U
PCB-1254	UG/KG		39 U	38 U	40 U	38 U
PCB-1260	UG/KG		39 U	38 U	40 U	38 U
PESTICIDES						
4,4'-DDD	UG/KG		3.9 U	3.8 U	4 U	3.8 U
4,4'-DDE	UG/KG		3.9 U	3.8 U	4 U	3.8 U
4,4'-DDT	UG/KG		3.9 U	3.8 U	4 U	3.8 U
A-ENDOSULFAN	UG/KG		2 U	1.9 U	2.1 U	2 U
ALDRIN	UG/KG		2 U	1.9 U	2.1 U	2 U
ALPHA-BHC	UG/KG		2 U	1.9 U	2.1 U	2 U
ALPHA-CHLORDANE	UG/KG		2 U	1.9 U	2.1 U	2 U
B-ENDOSULFAN	UG/KG		3.9 U	3.8 U	4 U	3.8 U
BETA-BHC	UG/KG		2 U	1.9 U	2.1 U	2 U
DELTA-BHC	UG/KG		2 U	1.9 U	2.1 U	2 U
DIELDRIN	UG/KG		3.9 U	3.8 U	4 U	3.8 U
ENDOSULFAN SULFATE	UG/KG		3.9 U	3.8 U	4 U	3.8 U
ENDRIN	UG/KG		3.9 U	3.8 U	4 U	3.8 U
ENDRIN ALDEHYDE	UG/KG		3.9 U	3.8 U	4 U	3.8 U
ENDRIN KETONE	UG/KG		3.9 U	3.8 U	4 U	3.8 U
GAMMA-BHC (LINDANE)	UG/KG		2 U	1.9 U	2.1 U	2 U
GAMMA-CHLORDANE	UG/KG		2 U	1.9 U	2.1 U	2 U
HEPTACHLOR	UG/KG		2 U	1.9 U	2.1 U	2 U
HEPTACHLOR EPOXIDE	UG/KG		2 U	1.9 U	2.1 U	2 U
METHOXYCHLOR	UG/KG		20 U	19 U	21 U	20 U
TOXAPHENE	UG/KG		200 U	190 U	210 U	200 U
SVOCs						
1,2-DICHLOROBENZENE	UG/KG			380 U	400 U	380 U
1,2,4-TRICHLOROBENZENE	UG/KG			380 U	400 U	380 U
1,3-DICHLOROBENZENE	UG/KG			380 U	400 U	380 U
1,4-DICHLOROBENZENE	UG/KG			380 U	400 U	380 U
2-CHLORONAPHTHALENE	UG/KG			380 U	400 U	380 U
2-CHLOROPHENOL	UG/KG			380 U	400 U	380 U

TABLE C-1.c.1b
ABG SEDIMENT SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME	UNITS	SD03BG05	SD03BG06	SD03BG08,D	SD03BG11	SD03BG08
ANALYTES						
SVOCs, cont.						
2-METHYL-4,6-DINITROPHENOL	UG/KG			950 U	1000 U	960 U
2-METHYLNAPHTHALENE	UG/KG			380 U	400 U	380 U
2-METHYLPHENOL (O-CRESOL)	UG/KG			380 U	400 U	380 U
2-NITROANILINE	UG/KG			950 U	1000 U	960 U
2-NITROPHENOL	UG/KG			380 U	400 U	380 U
2,4-DICHLOROPHENOL	UG/KG			380 U	400 U	380 U
2,4-DIMETHYLPHENOL	UG/KG			380 U	400 U	380 U
2,4-DINITROPHENOL	UG/KG			950 U	1000 U	960 U
2,4,5-TRICHLOROPHENOL	UG/KG			950 U	1000 U	960 U
2,4,6-TRICHLOROPHENOL	UG/KG			380 U	400 U	380 U
3-NITROANILINE	UG/KG			950 U	1000 U	960 U
3,3'-DICHLOROBENZIDINE	UG/KG			380 U	400 U	380 U
4-BROMOPHENYL PHENYL ETHER	UG/KG			380 U	400 U	380 U
4-CHLORO-3-METHYLPHENOL	UG/KG			380 U	400 U	380 U
4-CHLOROANILINE	UG/KG			380 U	400 U	380 U
4-CHLOROPHENYL PHENYL ETHER	UG/KG			380 U	400 U	380 U
4-METHYLPHENOL (P-CRESOL)	UG/KG			380 U	400 U	380 U
4-NITROANILINE	UG/KG			950 U	1000 U	960 U
4-NITROPHENOL	UG/KG			950 U	1000 U	960 U
ACENAPHTHENE	UG/KG			380 U	400 U	380 U
ACENAPHTHYLENE	UG/KG			380 U	400 U	380 U
ANTHRACENE	UG/KG			380 U	400 U	380 U
BENZO(A)ANTHRACENE	UG/KG			380 U	400 U	380 U
BENZO(A)PYRENE	UG/KG			380 U	400 U	380 U
BENZO(B)FLUORANTHENE	UG/KG			380 U	400 U	380 U
BENZO(G,H,I)PERYLENE	UG/KG			380 U	400 U	380 U
BENZO(K)FLUORANTHENE	UG/KG			380 U	400 U	380 U
BIS(2-CHLOROETHOXY)METHANE	UG/KG			380 U	400 U	380 U
BIS(2-CHLOROETHYL) ETHER	UG/KG			380 U	400 U	380 U
BIS(2-CHLOROISOPROPYL) ETHER	UG/KG			380 U	400 U	380 U
BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG			380 U	400 U	380 U
BUTYLBENZYLPHTHALATE	UG/KG			380 U	400 U	380 U
CARBAZOLE	UG/KG			380 U	400 U	380 U
CHRYSENE	UG/KG			380 U	400 U	380 U
DIBENZOFURAN	UG/KG			380 U	400 U	380 U
DIBENZO(A,H)ANTHRACENE	UG/KG			380 U	400 U	380 U
DIETHYL PHTHALATE	UG/KG			380 U	400 U	380 U
DIMETHYL PHTHALATE	UG/KG			380 U	400 U	380 U
DI-N-BUTYL PHTHALATE	UG/KG			72 J	790	79 J

TA[illegible]C-1.c.1b
AB[illegible]MENT SAMPLE RESULTS
199[illegible]UTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME	UNITS	SD03BG05	SD03BG06	SD03BG08,D	SD03BG11	SD03BG08
ANALYTES						
SVOCs, cont.						
DI-N-OCTYL PHTHALATE	UG/KG			380 U	400 U	380 U
FLUORANTHENE	UG/KG			380 U	400 U	380 U
FLUORENE	UG/KG			380 U	400 U	380 U
HEXACHLOROBENZENE	UG/KG			380 U	400 U	380 U
HEXACHLOROBUTADIENE	UG/KG			380 U	400 U	380 U
HEXACHLOROCYCLOPENTADIENE	UG/KG			380 U	400 U	380 U
HEXACHLOROETHANE	UG/KG			380 U	400 U	380 U
INDENO(1,2,3-CD)PYRENE	UG/KG			380 U	400 U	380 U
ISOPHORONE	UG/KG			380 U	400 U	380 U
NAPHTHALENE	UG/KG			380 U	400 U	380 U
N-NITROSO-DI-N-PROPYLAMINE	UG/KG			380 U	400 U	380 U
N-NITROSODIPHENYLAMINE	UG/KG			380 U	85 J	380 U
PENTACHLOROPHENOL	UG/KG			950 U	1000 U	960 U
PHENANTHRENE	UG/KG			380 U	400 U	380 U
PHENOL	UG/KG			380 U	400 U	380 U
PYRENE	UG/KG			380 U	400 U	380 U
VOCs						
1,1-DICHLOROETHANE	UG/KG			11 UJ	12 UJ	12 UJ
1,1-DICHLOROETHENE	UG/KG			11 U	12 U	12 U
1,1,1-TRICHLOROETHANE	UG/KG			11 U	12 U	12 U
1,1,2-TRICHLOROETHANE	UG/KG			11 U	12 U	12 U
1,1,2,2-TETRACHLOROETHANE	UG/KG			11 U	12 U	12 U
1,2-DICHLOROETHANE	UG/KG			11 UJ	12 UJ	12 UJ
1,2-DICHLOROETHENE(TOTAL)	UG/KG			11 U	12 U	12 U
1,2-DICHLOROPROPANE	UG/KG			11 UJ	12 UJ	12 UJ
2-BUTANONE (MEK)	UG/KG			11 U	12 U	12 U
2-HEXANONE	UG/KG			11 U	12 U	12 U
4-METHYL-2-PENTANONE (MIBK)	UG/KG			11 U	12 U	12 U
ACETONE	UG/KG			15 BJU	17 BJU	12 UJ
BENZENE	UG/KG			11 U	12 U	12 U
BROMODICHLOROMETHANE	UG/KG			11 U	12 U	12 U
BROMOFORM	UG/KG			11 U	12 U	12 U
BROMOMETHANE (METHYL BROMIDE)	UG/KG			11 U	12 U	12 U
CARBON DISULFIDE	UG/KG			11 U	12 U	12 U
CARBON TETRACHLORIDE	UG/KG			11 U	12 U	12 U
CHLOROBENZENE	UG/KG			11 U	12 U	12 U
CHLOROETHANE	UG/KG			11 U	12 U	12 U
CHLOROFORM	UG/KG			11 U	12 U	12 U
CHLOROMETHANE (METHYL CHLORIDE)	UG/KG			11 U	12 U	12 U

TABLE C-1.c.1b
ABG SEDIMENT SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME	UNITS	SD03BG05	SD03BG06	SD03BG08,D	SD03BG11	SD03BG08
ANALYTES						
VOCs, cont.						
CIS-1,3-DICHLOROPROPENE	UG/KG			11 U	12 U	12 U
DIBROMOCHLOROMETHANE	UG/KG			11 U	12 U	12 U
ETHYLBENZENE	UG/KG			11 U	12 U	12 U
METHYLENE CHLORIDE	UG/KG			22 BJU	22 BJU	19 BJU
STYRENE	UG/KG			11 U	12 U	12 U
TETRACHLOROETHENE	UG/KG			11 U	12 U	12 U
TOLUENE	UG/KG			11 U	12 U	12 U
TRANS-1,3-DICHLOROPROPENE	UG/KG			11 U	12 U	12 U
TRICHLOROETHENE	UG/KG			11 U	12 U	12 U
VINYL CHLORIDE	UG/KG			11 U	12 U	12 U
XYLENE, TOTAL	UG/KG			11 U	12 U	12 U
WATER QUALITY PARAMETER						
TOTAL SOLIDS	%	73	85	88	82	87

TABLE C-1.e
ABG GROUND SAMPLE RESULTS
1997 SOUTHWE B
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER	UNITS	BVRBND	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	GOLCON	GOLCON	GOLCON	GOLCON	ALLUV	ALLUV
SAMPLE NAME		03C01	03-13	03-16	03-21	03C15	03C20	03C08AP3	03C08AP3,D	03C19P3	03C23	03B07	03B05
EXPLOSIVES													
1,3-DINITROBENZENE	UG/L	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U		1.3 U	1.3 U
1,3,5-TRINITROBENZENE	UG/L	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	5.1	1.3 U	1.3 U	1.3 U		1.3 U	1.3 U
2-AMINO-4,6-DINITROTOLUENE	UG/L	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	12 J	1.3 U	1.3 U	1.3 U		1.3 U	1.3 U
2,4-DINITROTOLUENE	UG/L	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U		1.3 U	1.3 U
2,4-DINITROTOLUENE(2)	UG/L				5 UJ			5 UJ	5 UJ	5 UJ			
2,4,6-TRINITROTOLUENE (TNT)	UG/L	1.3 U	0.55 J	1.3 U	7.8	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U		1.3 U	1.3 U
2,6-DINITROTOLUENE	UG/L	1.3 U	0.78 J	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U		1.3 U	1.3 U
2,6-DINITROTOLUENE(2)	UG/L				5 U			5 U	5 U	5 U			
4-AMINO-2,6-DINITROTOLUENE	UG/L	1.3 U	0.93 J	1.3 U	5.1	1.3 U	18	1.3 U	1.3 U	1.3 U		1.3 U	1.3 U
HMX	UG/L	1.3 U	84	0.81 J	160	1.3 U	29	2	2	1.3 U		1.3 U	1.3 U
M-NITROTOLUENE	UG/L	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U		1.3 U	1.3 U
NITROBENZENE	UG/L	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U		1.3 U	1.3 U
NITROBENZENE(2)	UG/L				5 U			5 U	5 U	5 U			
O-NITROTOLUENE	UG/L	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U		1.3 U	1.3 U
P-NITROTOLUENE	UG/L	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U		1.3 U	1.3 U
RDX	UG/L	1.3 U	67	25	310	1.3 U	170	1.2 J	1.1 J	1.3 U		1.3 U	1.3 U
TETRYL	UG/L	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U	1.3 U		1.3 U	1.3 U
INORGANICS													
ALUMINUM, DISSOLVED	UG/L				72.9			50 U	50 U	50 U	50 U	50 U	50 U
ALUMINUM, TOTAL	UG/L				14700 J			1020 J	1100 J	101 U	55800 J	1950	715
ANTIMONY, DISSOLVED	UG/L				8 U			8 U	8 U	8 U	8 U	8 U	8 U
ANTIMONY, TOTAL	UG/L				11 J			8 U	8 U	8 U	52 J	8 U	8 U
ARSENIC, DISSOLVED	UG/L				1 UJ			1.4 J	2.1 J	1.5 J	1.1	1 UJ	2.6 J
ARSENIC, TOTAL	UG/L				21 J			3.6 J	3.3 J	1 UJ	74 J	2.3 J	4.4 J
BARIUM, DISSOLVED	UG/L				95.4			95	95.4	11.8	139	43.9	35.8
BARIUM, TOTAL	UG/L				288			115	110	12.3	1470	71.9	62
BERYLLIUM, DISSOLVED	UG/L				1 U			1 U	1 U	1 U	1 U	1 U	1 U
BERYLLIUM, TOTAL	UG/L				1.4			1 U	1 U	1 U	7.5	1 U	1 U
CADMIUM, DISSOLVED	UG/L				2 U			2 U	2 U	2 U	2 U	2 U	2 U
CADMIUM, TOTAL	UG/L				2.9 U			2 U	2 U	2 U	2 U	2 U	2 U
CALCIUM, DISSOLVED	UG/L				80500			120000 J	116000 J	120000 J	146000	38900 J	27100 J
CALCIUM, TOTAL	UG/L				123000 J			116000 J	114000 J	111000 J	230000 J	44200	26700
CHROMIUM, DISSOLVED	UG/L				5 U			5 U	5 U	5 U	5 U	5 U	5 U
CHROMIUM, TOTAL	UG/L				23.2 J			5.6	6.7	5 U	86.9 J	6.2	5 U
COBALT, DISSOLVED	UG/L				5 U			5 U	5 U	5 U	5 U	5 U	5 U
COBALT, TOTAL	UG/L				22.1			6.6	6.4	5 U	137	5 U	5 U
COPPER, DISSOLVED	UG/L				5 U			5 U	5 U	5 U	5 U	5 U	5 U
COPPER, TOTAL	UG/L				26.8 U			5 U	5 U	5 U	107 J	7.3	15.2
CYANIDE	MG/L				0.005 U			0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.0057 U

TABLE C-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER	UNITS	BVRBND	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	GOLCON	GOLCON	GOLCON	GOLCON	ALLUV	ALLUV
SAMPLE NAME		03C01	03-13	03-16	03-21	03C15	03C20	03C08AP3	03C08AP3,D	03C19P3	03C23	03B07	03B05
INORGANICS, cont.													
IRON, DISSOLVED	UG/L				100			50 U	50 U	50 U	50 U	50 U	50 U
IRON, TOTAL	UG/L				31600			4200 J	4040 J	358 J	144000	6020	3160
LEAD, DISSOLVED	UG/L				1 U			1 U	1 UJ	5 U	1 UJ	1 U	1 U
LEAD, TOTAL	UG/L				45 J			2.1 J	1.7 J	5 U	160 J	7.6	5.2 J
MAGNESIUM, DISSOLVED	UG/L				14200			11500	11300	100000	18800	7330	5240
MAGNESIUM, TOTAL	UG/L				22400			12400 J	12300 J	92100 J	32700	11300	5160
MANGANESE, DISSOLVED	UG/L				21.5			19.1 B	22.7 B	123	90.2	5 U	793
MANGANESE, TOTAL	UG/L				2050			348 J	337 J	124 J	11500	562	1990
MERCURY, DISSOLVED	UG/L				0.2 U			0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
MERCURY, TOTAL	UG/L				0.2 U			0.2 U	0.2 U	0.2 U	0.64	0.2 U	0.2 U
NICKEL, DISSOLVED	UG/L				20 U			20 U	20 U	20 U	20 U	20 U	20 U
NICKEL, TOTAL	UG/L				64			20 U	22.9	20 U	332	20 U	20 U
POTASSIUM, DISSOLVED	UG/L				2800			1000 U	1130	4190	1960	1000 U	1270
POTASSIUM, TOTAL	UG/L				6870 J			1000 U	1200	3450	13200 J	1000 U	2370
SELENIUM, DISSOLVED	UG/L				1 UJ			5 UR	5 UR	5 UR	5 U	1 UR	1 UR
SELENIUM, TOTAL	UG/L				5 UR			5 UR	5 UR	5 UR	5 UR	5 UR	1 UR
SILVER, DISSOLVED	UG/L				5 U			5 U	5 U	5 U	5 U	5 U	5 U
SILVER, TOTAL	UG/L				5 U			5 U	5 U	5 U	9.5	5 U	5 U
SODIUM, DISSOLVED	UG/L				2450			4600	4630	67300	17900	2030	15800
SODIUM, TOTAL	UG/L				2770			4620	4530	62300	18000	1920	15000
THALLIUM, DISSOLVED	UG/L				1 U			1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
THALLIUM, TOTAL	UG/L				1 UJ			1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
VANADIUM, DISSOLVED	UG/L				5 U			5 U	5 U	5 U	5 U	5 U	5 U
VANADIUM, TOTAL	UG/L				26.4 J			5 U	5 U	5 U	85.7 J	6.8	5 U
ZINC, DISSOLVED	UG/L				5 U			5 U	5 U	5 U	5	6.2 U	7.2 U
ZINC, TOTAL	UG/L				161 J			29.4 J	30.8 J	5 UJ	454 J	23.9 UJ	26.7 UJ
PCBs													
PCB-1016	UG/L				0.2 U			0.2 U	0.2 U	0.2 U			
PCB-1221	UG/L				0.4 U			0.4 U	0.4 U	0.4 U			
PCB-1232	UG/L				0.2 U			0.2 U	0.2 U	0.2 U			
PCB-1242	UG/L				0.2 U			0.2 U	0.2 U	0.2 U			
PCB-1248	UG/L				0.2 U			0.2 U	0.2 U	0.2 U			
PCB-1254	UG/L				0.2 U			0.2 U	0.2 U	0.2 U			
PCB-1260	UG/L				0.2 U			0.2 U	0.2 U	0.2 U			
PESTICIDES													
4,4'-DDD	UG/L				0.02 U			0.02 U	0.02 U	0.02 U			
4,4'-DDE	UG/L				0.02 U			0.02 U	0.02 U	0.02 U			
4,4'-DDT	UG/L				0.02 U			0.02 U	0.02 U	0.02 U			
A-ENDOSULFAN	UG/L				0.01 U			0.01 U	0.01 U	0.01 U			

TABLE C-1.e
ABG GROUND [illegible]AMPLE RESULTS
1997 SOUTHWEST[illegible]B
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER	UNITS	BVRBND	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	GOLCON	GOLCON	GOLCON	GOLCON	ALLUV	ALLUV
SAMPLE NAME		03C01	03-13	03-16	03-21	03C15	03C20	03C08AP3	03C08AP3,D	03C19P3	03C23	03B07	03B05
PCBs, cont.													
ALDRIN	UG/L				0.01 U			0.01 U	0.01 U	0.01 U			
ALPHA-BHC	UG/L				0.01 U			0.01 U	0.01 U	0.01 U			
ALPHA-CHLORDANE	UG/L				0.01 U			0.01 U	0.01 U	0.01 U			
B-ENDOSULFAN	UG/L				0.02 U			0.02 U	0.02 U	0.02 U			
BETA-BHC	UG/L				0.01 U			0.01 U	0.01 U	0.01 U			
DELTA-BHC	UG/L				0.01 U			0.01 U	0.01 U	0.01 U			
DIELDRIN	UG/L				0.02 U			0.02 U	0.02 U	0.02 U			
ENDOSULFAN SULFATE	UG/L				0.02 U			0.02 U	0.02 U	0.02 U			
ENDRIN	UG/L				0.02 U			0.02 U	0.02 U	0.02 U			
ENDRIN ALDEHYDE	UG/L				0.02 U			0.02 U	0.02 U	0.02 U			
ENDRIN KETONE	UG/L				0.02 U			0.02 U	0.02 U	0.02 U			
GAMMA-BHC (LINDANE)	UG/L				0.01 U			0.01 U	0.01 U	0.01 U			
GAMMA-CHLORDANE	UG/L				0.01 U			0.01 U	0.01 U	0.01 U			
HEPTACHLOR	UG/L				0.01 U			0.01 U	0.01 U	0.01 U			
HEPTACHLOR EPOXIDE	UG/L				0.01 U			0.01 U	0.01 U	0.01 U			
METHOXYCHLOR	UG/L				0.1 U			0.1 U	0.1 U	0.1 U			
TOXAPHENE	UG/L				1 U			1 U	1 U	1 U			
SVOCs													
1,2-DICHLOROBENZENE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
1,2,4-TRICHLOROBENZENE	UG/L				5 U			5 U	5 U	5 U			
1,3-DICHLOROBENZENE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
1,4-DICHLOROBENZENE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
2-CHLORONAPHTHALENE	UG/L				5 U			5 U	5 U	5 U			
2-CHLOROPHENOL	UG/L				5 U			5 U	5 U	5 U			
2-METHYL-4,6-DINITROPHENOL	UG/L				20 U			20 U	20 U	20 U			
2-METHYLNAPHTHALENE	UG/L				5 U			5 U	5 U	5 U			
2-METHYLPHENOL (O-CRESOL)	UG/L				5 U			5 U	5 U	5 U			
2-NITROANILINE	UG/L				20 U			20 U	20 U	20 U			
2-NITROPHENOL	UG/L				5 U			5 U	5 U	5 U			
2,4-DICHLOROPHENOL	UG/L				5 UJ			5 UJ	5 UJ	5 UJ			
2,4-DIMETHYLPHENOL	UG/L				5 U			5 U	5 U	5 U			
2,4-DINITROPHENOL	UG/L				20 UJ			20 UJ	20 UJ	20 UJ			
2,4,5-TRICHLOROPHENOL	UG/L				20 U			20 U	20 U	20 U			
2,4,6-TRICHLOROPHENOL	UG/L				5 U			5 U	5 U	5 U			
3-NITROANILINE	UG/L				20 U			20 U	20 U	20 U			
3,3'-DICHLOROBENZIDINE	UG/L				5 UJ			5 UJ	5 UJ	5 UJ			
4-BROMOPHENYL PHENYL ETHER	UG/L				5 U			5 U	5 U	5 U			
4-CHLORO-3-METHYLPHENOL	UG/L				5 U			5 U	5 U	5 U			
4-CHLOROANILINE	UG/L				5 U			5 U	5 U	5 U			

TABLE C-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER	UNITS	BVRBND	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	GOLCON	GOLCON	GOLCON	GOLCON	ALLUV	ALLUV
SAMPLE NAME		03C01	03-13	03-16	03-21	03C15	03C20	03C08AP3	03C08AP3,D	03C19P3	03C23	03B07	03B05
SVOCs, cont.													
4-CHLOROPHENYL PHENYL ETHER	UG/L				5 U			5 U	5 U	5 U			
4-METHYLPHENOL (P-CRESOL)	UG/L				5 U			5 U	5 U	5 U			
4-NITROANILINE	UG/L				20 UJ			20 UJ	20 UJ	20 UJ			
4-NITROPHENOL	UG/L				20 U			20 U	20 U	20 U			
ACENAPHTHENE	UG/L				5 U			5 U	5 U	5 U			
ACENAPHTHYLENE	UG/L				5 U			5 U	5 U	5 U			
ANTHRACENE	UG/L				5 U			5 U	5 U	5 U			
BENZO(A)ANTHRACENE	UG/L				5 U			5 U	5 U	5 U			
BENZO(A)PYRENE	UG/L				5 U			5 U	5 U	5 U			
BENZO(B)FLUORANTHENE	UG/L				5 U			5 U	5 U	5 U			
BENZO(G,H,I)PERYLENE	UG/L				5 U			5 U	5 U	5 U			
BENZO(K)FLUORANTHENE	UG/L				5 U			5 U	5 U	5 U			
BIS(2-CHLOROETHOXY)METHANE	UG/L				5 U			5 U	5 U	5 U			
BIS(2-CHLOROETHYL) ETHER	UG/L				5 U			5 U	5 U	5 U			
BIS(2-CHLOROISOPROPYL) ETHER	UG/L				5 U			5 U	5 U	5 U			
BIS(2-ETHYLHEXYL) PHTHALATE	UG/L				1.7 J			5 U	5 U	5.2			
BUTYLBENZYLPHTHALATE	UG/L				5 U			5 U	5 U	5 U			
CHRYSENE	UG/L				5 U			5 U	5 U	5 U			
DIBENZOFURAN	UG/L				5 U			5 U	5 U	5 U			
DIBENZO(A,H)ANTHRACENE	UG/L				5 U			5 U	5 U	5 U			
DIETHYL PHTHALATE	UG/L				5 U			5 U	5 U	5 U			
DIMETHYL PHTHALATE	UG/L				5 U			5 U	5 U	5 U			
DI-N-BUTYL PHTHALATE	UG/L				5 U			5 U	5 U	5 U			
DI-N-OCTYL PHTHALATE	UG/L				5 U			5 U	5 U	5 U			
FLUORANTHENE	UG/L				5 U			5 U	5 U	5 U			
FLUORENE	UG/L				5 U			5 U	5 U	5 U			
HEXACHLOROBENZENE	UG/L				5 U			5 U	5 U	5 U			
HEXACHLOROBUTADIENE	UG/L				5 U			5 U	5 U	5 U			
HEXACHLOROCYCLOPENTADIENE	UG/L				5 UJ			5 UJ	5 UJ	5 UJ			
HEXACHLOROETHANE	UG/L				5 U			5 U	5 U	5 U			
INDENO(1,2,3-CD)PYRENE	UG/L				5 U			5 U	5 U	5 U			
ISOPHORONE	UG/L				5 U			5 U	5 U	5 U			
NAPHTHALENE	UG/L				5 U			5 U	5 U	5 U			
N-NITROSO-DI-N-PROPYLAMINE	UG/L				5 U			5 U	5 U	5 U			
N-NITROSODIPHENYLAMINE	UG/L				5 U			5 U	5 U	5 U			
PENTACHLOROPHENOL	UG/L				20 U			20 U	20 U	20 U			
PHENANTHRENE	UG/L				5 U			5 U	5 U	5 U			
PHENOL	UG/L				5 U			5 U	5 U	5 U			
PYRENE	UG/L				5 U			5 U	5 U	5 U			

TABLE C-1.e
ABG GROUND [illegible]AMPLE RESULTS
1997 SOUTHWEST[illegible]
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER	UNITS	BVRBND	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	GOLCON	GOLCON	GOLCON	GOLCON	ALLUV	ALLUV
SAMPLE NAME		03C01	03-13	03-16	03-21	03C15	03C20	03C08AP3	03C08AP3,D	03C19P3	03C23	03B07	03B05
VOCs													
1,1-DICHLOROETHANE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
1,1-DICHLOROETHENE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
1,1,1-TRICHLOROETHANE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
1,1,2-TRICHLOROETHANE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
1,1,2,2-TETRACHLOROETHANE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
1,2-DIBROMO-3-CHLOROPROPANE	UG/L	1 UR			1 U		1 UR	1 UR	1 UR	1 UR			
1,2-DIBROMOETHANE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
1,2-DICHLOROETHANE	UG/L	1 U			1 U		1.1	1 U	1 U	1 U			
1,2-DICHLOROPROPANE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
2-BUTANONE (MEK)	UG/L	5 UR			5 UR		5 UR	5 UR	5 UR	5 UR			
2-HEXANONE	UG/L	5 U			5 U		5 U	5 U	5 U	5 U			
4-METHYL-2-PENTANONE (MIBK)	UG/L	5 U			5 U		5 U	5 U	5 U	5 U			
ACETONE	UG/L	5 UR			5 UR		5 UR	5 UR	5 UR	5 UR			
BENZENE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
BROMOCHLOROMETHANE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
BROMODICHLOROMETHANE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
BROMOFORM	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
BROMOMETHANE (METHYL BROMIDE)	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
CARBON DISULFIDE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
CARBON TETRACHLORIDE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
CHLOROBENZENE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
CHLOROETHANE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
CHLOROFORM	UG/L	1 U			1 U		2 UB	1 U	1 U	1 U			
CHLOROMETHANE (METHYL CHLORIDE)	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
CIS-1,2-DICHLOROETHENE	UG/L	1 U			1 U		49 J	1 U	1 U	1 U			
CIS-1,3-DICHLOROPROPENE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
DIBROMOCHLOROMETHANE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
ETHYLBENZENE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
METHYLENE CHLORIDE	UG/L	4 BU			3 BU		4 BU	4 BU	3 BU	4 BJU			
STYRENE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
TETRACHLOROETHENE	UG/L	1 U			1 U		1.2	1 U	1 U	1 U			
TOLUENE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
TRANS-1,2-DICHLOROETHENE	UG/L	1 U			1 U		6	1 U	1 U	1 U			
TRANS-1,3-DICHLOROPROPENE	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
TRICHLOROETHENE	UG/L	1 U			0.3 J		2800 D	1 U	1 U	1 U			
VINYL CHLORIDE	UG/L	1 U			1 U		2	1 U	1 U	1 U			
XYLENE, TOTAL	UG/L	1 U			1 U		1 U	1 U	1 U	1 U			
WATER QUALITY PARAMETERS													
ALKALINITY	MG/L	380	240	170	390	300	260	320	320	400	310	120	120

TABLE C-1.e.1
ABG GROUND WATER SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER	UNITS	BVRBND	BCH CRK	BCH CRK	BCH CRK	BCH CRK	BCH CRK	GOLCON	GOLCON	GOLCON	GOLCON	ALLUV	ALLUV
SAMPLE NAME		03C01	03-13	03-16	03-21	03C15	03C20	03C08AP3	03C08AP3,D	03C19P3	03C23	03B07	03B05
WATER QUALITY PARAMETERS, cont.													
CHEMICAL OXYGEN DEMAND	MG/L	5 U	5 U	5 U	5 U	5 U	35	5 U	5 U	5 U	18	5 U	5 U
CHLORIDE	MG/L	1.3	5.2	3.7	1.6	3.7	6	6.1	6.5	3.1	20	1.1	1 U
NITROGEN (NO2+NO3)	MG/L	0.022	0.34	2.5	1.4 J	0.02 UJ	1.7 J	0.042 J	0.055 J	0.02 UJ	0.17 U	0.18 J	0.049 UJ
PH	PH UN	8.8	7.4	7.8	7.3	7.5	7.7	6.7	6.9	7.7	7.3	7.1	7.5
SULFATE	MG/L	91	38	19	18	160 J	100 J	25 J	25 J	440 J	43	14 J	3 J
TOTAL DISSOLVED SOLIDS	MG/L	550	300	250	330	580	500	400	400	1100	430	150	140

TABLE C[illegible] 1
ORR SUR[illegible]UBSURFACE SOIL SAMPLE RESULTS
1997 SOU[illegible]ST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		070101	070501	070901	071201	070504	070504, D	071204
ANALYTES		Surface	Surface	Surface	Surface	Subsurf.	Subsurf.	Subsurf.
EXPLOSIVES								
2,4-DINITROTOLUENE	UG/KG	420 U						
2,6-DINITROTOLUENE	UG/KG	420 U						
NITROBENZENE	UG/KG	420 U						
INORGANICS								
ALUMINUM, TOTAL	MG/KG	6690 J	5770 J	5940 J	6110 J	6240 J	5330 J	8930 J
ANTIMONY, TOTAL	MG/KG	5.1 UJ	4.8 UJ	4.6 UJ	5.3 J	4.7 UJ	7.8 J	4.7 UJ
ARSENIC, TOTAL	MG/KG	3.2 J	6.9 J	5.7 J	5.8 J	5.7 J	5.8 J	8 J
BARIUM, TOTAL	MG/KG	106	273	49.4	83.4	134	167	48.5
BERYLLIUM, TOTAL	MG/KG	1.2	0.46	0.37	1	0.83	1.1	0.46
CADMIUM, TOTAL	MG/KG	1.3 U	1.2 U	1.1 U	1.3 U	1.2 U	1.2 U	1.2 U
CALCIUM, TOTAL	MG/KG	550 J	42900 J	16600 J	1330 J	3460 J	3820 J	369
CHROMIUM, TOTAL	MG/KG	8.2 J	13.4 J	10.3 J	18.6 J	17.6 J	19.3 J	9.2 J
COBALT, TOTAL	MG/KG	13.2	9	5.7	10.3	14.4	14.5	9.6
COPPER, TOTAL	MG/KG	23	21.1	35.9	9.9	11	10.3	6.8
CYANIDE	MG/KG	0.63 U	0.59 UJ	0.57 UJ	0.63 UJ	0.58 UJ	0.57 UJ	0.58 UJ
IRON, TOTAL	MG/KG	10500 J	15000 J	13100 J	24700 J	23100 J	39600 J	16700 J
LEAD, TOTAL	MG/KG	32.3	40.1 J	49.3	68.3	18.3	16.5	14.7
MAGNESIUM, TOTAL	MG/KG	799	2640	2810	644	795	682	983
MANGANESE, TOTAL	MG/KG	1660 J	588 J	357 J	1220 J	1150 J	1200 J	765 J
MERCURY, TOTAL	MG/KG	0.13 U	0.12 U	0.11 U	0.13 U	0.12 U	0.12 U	0.12 U
NICKEL, TOTAL	MG/KG	16.7	10.9	6.1	9.8	15.7	17.3	7.5
POTASSIUM, TOTAL	MG/KG	382 U	548	344 U	379 U	350 U	351	453
SELENIUM, TOTAL	MG/KG	0.25 UR	0.24 UR	0.23 UR	0.25 UR	0.23 UR	0.23 UR	0.23 UR
SILVER, TOTAL	MG/KG	1.3 U	1.2 U	1.1 U	1.6	1.2 U	2	1.2 U
SODIUM, TOTAL	MG/KG	102 U	97.1	91.7 U	101 U	93.2 U	92.8 U	93.8 U
THALLIUM, TOTAL	MG/KG	0.25 U	0.24 U	0.23 U	0.25 U	0.26	0.23 U	0.23 U
VANADIUM, TOTAL	MG/KG	14.4	19.5	18	24.1	21.8	26.8	21.6
ZINC, TOTAL	MG/KG	33.1 J	72.8 J	42.7 J	25.9 J	44.7 J	39.6 J	24.9 J
PCBs								
PCB-1016	UG/KG	42 U		38 U				
PCB-1221	UG/KG	85 U		77 U				
PCB-1232	UG/KG	42 U		38 U				
PCB-1242	UG/KG	42 U		38 U				
PCB-1248	UG/KG	42 U		38 U				
PCB-1254	UG/KG	42 U		38 U				
PCB-1260	UG/KG	42 U		38 U				
PESTICIDES								
4,4'-DDD	UG/KG	4.2 U		3.8 U				
4,4'-DDE	UG/KG	4.2 U		3.8 U				

TABLE C-2.a.1
ORR SURFACE/SUBSURFACE SOIL SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		070101	070501	070901	071201	070504	070504, D	071204
ANALYTES		Surface	Surface	Surface	Surface	Subsurf.	Subsurf.	Subsurf.
PESTICIDES, cont.								
4,4'-DDT	UG/KG	4.2 U		3.8 U				
A-ENDOSULFAN	UG/KG	2.2 U		1.9 U				
ALDRIN	UG/KG	2.2 U		1.9 U				
ALPHA-BHC	UG/KG	2.2 U		1.9 U				
ALPHA-CHLORDANE	UG/KG	2.2 U		1.9 U				
B-ENDOSULFAN	UG/KG	4.2 U		3.8 U				
BETA-BHC	UG/KG	2.2 U		1.9 U				
DELTA-BHC	UG/KG	2.2 U		1.9 U				
DIELDRIN	UG/KG	4.2 U		3.8 U				
ENDOSULFAN SULFATE	UG/KG	4.2 U		3.8 U				
ENDRIN	UG/KG	4.2 U		3.8 U				
ENDRIN ALDEHYDE	UG/KG	4.2 U		3.8 U				
ENDRIN KETONE	UG/KG	4.2 U		3.8 U				
GAMMA-BHC (LINDANE)	UG/KG	2.2 U		1.9 U				
GAMMA-CHLORDANE	UG/KG	2.2 U		1.9 U				
HEPTACHLOR	UG/KG	2.2 U		1.9 U				
HEPTACHLOR EPOXIDE	UG/KG	2.2 U		1.9 U				
METHOXYCHLOR	UG/KG	22 U		20 U				
TOXAPHENE	UG/KG	220 U		200 U				
SVOCs								
1,2-DICHLOROBENZENE	UG/KG	420 U						
1,2,4-TRICHLOROBENZENE	UG/KG	420 U						
1,3-DICHLOROBENZENE	UG/KG	420 U						
1,4-DICHLOROBENZENE	UG/KG	420 U						
2-CHLORONAPHTHALENE	UG/KG	420 U						
2-CHLOROPHENOL	UG/KG	420 U						
2-METHYL-4,6-DINITROPHENOL	UG/KG	1100 U						
2-METHYLNAPHTHALENE	UG/KG	420 U						
2-METHYLPHENOL (O-CRESOL)	UG/KG	420 U						
2-NITROANILINE	UG/KG	1100 U						
2-NITROPHENOL	UG/KG	420 U						
2,4-DICHLOROPHENOL	UG/KG	420 U						
2,4-DIMETHYLPHENOL	UG/KG	420 U						
2,4-DINITROPHENOL	UG/KG	1100 U						
2,4,5-TRICHLOROPHENOL	UG/KG	1100 U						
2,4,6-TRICHLOROPHENOL	UG/KG	420 U						
3-NITROANILINE	UG/KG	1100 U						
3,3'-DICHLOROBENZIDINE	UG/KG	420 U						
4-BROMOPHENYL PHENYL ETHER	UG/KG	420 U						

TABLE C[illegible]
ORR SUR[illegible]UBSURFACE SOIL SAMPLE RESULTS
1997 SOUTH[illegible]ST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		070101	070501	070901	071201	070504	070504, D	071204
ANALYTES		Surface	Surface	Surface	Surface	Subsurf.	Subsurf.	Subsurf.
SVOCs, cont.								
4-CHLORO-3-METHYLPHENOL	UG/KG	420 U						
4-CHLOROANILINE	UG/KG	420 U						
4-CHLOROPHENYL PHENYL ETHER	UG/KG	420 U						
4-METHYLPHENOL (P-CRESOL)	UG/KG	420 U						
4-NITROANILINE	UG/KG	1100 U						
4-NITROPHENOL	UG/KG	1100 U						
ACENAPHTHENE	UG/KG	420 U						
ACENAPHTHYLENE	UG/KG	420 U						
ANTHRACENE	UG/KG	420 U						
BENZO(A)ANTHRACENE	UG/KG	420 U						
BENZO(A)PYRENE	UG/KG	420 U						
BENZO(B)FLUORANTHENE	UG/KG	420 U						
BENZO(G,H,I)PERYLENE	UG/KG	420 UJ						
BENZO(K)FLUORANTHENE	UG/KG	420 U						
BIS(2-CHLOROETHOXY)METHANE	UG/KG	420 U						
BIS(2-CHLOROETHYL) ETHER	UG/KG	420 U						
BIS(2-CHLOROISOPROPYL) ETHER	UG/KG	420 U						
BIS(2-ETHYLHEXYL) PHTHALATE	UG/KG	420 U						
BUTYLBENZYLPHTHALATE	UG/KG	420 U						
CARBAZOLE	UG/KG	420 U						
CHRYSENE	UG/KG	420 U						
DIBENZOFURAN	UG/KG	420 U						
DIBENZO(A,H)ANTHRACENE	UG/KG	420 U						
DIETHYL PHTHALATE	UG/KG	420 U						
DIMETHYL PHTHALATE	UG/KG	420 U						
DI-N-BUTYL PHTHALATE	UG/KG	77 J						
DI-N-OCTYL PHTHALATE	UG/KG	420 U						
FLUORANTHENE	UG/KG	420 U						
FLUORENE	UG/KG	420 U						
HEXACHLOROBENZENE	UG/KG	420 U						
HEXACHLOROBUTADIENE	UG/KG	420 U						
HEXACHLOROCYCLOPENTADIENE	UG/KG	420 U						
HEXACHLOROETHANE	UG/KG	420 U						
INDENO(1,2,3-CD)PYRENE	UG/KG	420 U						
ISOPHORONE	UG/KG	420 U						
NAPHTHALENE	UG/KG	420 U						
N-NITROSO-DI-N-PROPYLAMINE	UG/KG	420 U						
N-NITROSODIPHENYLAMINE	UG/KG	420 U						
PENTACHLOROPHENOL	UG/KG	1100 U						

TABLE C-2.a.1
ORR SURFACE/SUBSURFACE SOIL SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

SAMPLE NAME		070101	070501	070901	071201	070504	070504, D	071204
ANALYTES		Surface	Surface	Surface	Surface	Subsurf.	Subsurf.	Subsurf.
SVOCs, cont.								
PHENANTHRENE	UG/KG	420 U						
PHENOL	UG/KG	420 U						
PYRENE	UG/KG	420 U						
VOCs								
1,1-DICHLOROETHANE	UG/KG	13 UJ						
1,1-DICHLOROETHENE	UG/KG	13 UJ						
1,1,1-TRICHLOROETHANE	UG/KG	13 UJ						
1,1,2-TRICHLOROETHANE	UG/KG	13 UJ						
1,1,2,2-TETRACHLOROETHANE	UG/KG	13 UJ						
1,2-DICHLOROETHANE	UG/KG	13 UJ						
1,2-DICHLOROETHENE(TOTAL)	UG/KG	13 UJ						
1,2-DICHLOROPROPANE	UG/KG	13 UJ						
2-BUTANONE (MEK)	UG/KG	13 UJ						
2-HEXANONE	UG/KG	13 UJ						
4-METHYL-2-PENTANONE (MIBK)	UG/KG	13 UJ						
ACETONE	UG/KG	13 UJ						
BENZENE	UG/KG	13 UJ						
BROMODICHLOROMETHANE	UG/KG	13 UJ						
BROMOFORM	UG/KG	13 UJ						
BROMOMETHANE (METHYL BROMIDE)	UG/KG	13 UJ						
CARBON DISULFIDE	UG/KG	13 UJ						
CARBON TETRACHLORIDE	UG/KG	13 UJ						
CHLOROBENZENE	UG/KG	13 UJ						
CHLOROETHANE	UG/KG	13 UJ						
CHLOROFORM	UG/KG	13 UJ						
CHLOROMETHANE (METHYL CHLORIDE)	UG/KG	13 UJ						
CIS-1,3-DICHLOROPROPENE	UG/KG	13 UJ						
DIBROMOCHLOROMETHANE	UG/KG	13 UJ						
ETHYLBENZENE	UG/KG	13 UJ						
METHYLENE CHLORIDE	UG/KG	13 UJ						
STYRENE	UG/KG	13 UJ						
TETRACHLOROETHENE	UG/KG	13 UJ						
TOLUENE	UG/KG	13 UJ						
TRANS-1,3-DICHLOROPROPENE	UG/KG	13 UJ						
TRICHLOROETHENE	UG/KG	13 UJ						
VINYL CHLORIDE	UG/KG	13 UJ						
XYLENE, TOTAL	UG/KG	13 UJ						
WATER QUALITY PARAMETER								
TOTAL SOLIDS	%	79	83	87	79	86	86	85

TABLE C-2.d.1
ORR GROUND WATER SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER	UNITS	BCH CRK	GOLCON	GOLCON
SAMPLE NAME		06C09	06C16P3	06C16P3,D
INORGANICS				
ALUMINUM, DISSOLVED	UG/L	50 U	50 U	
ALUMINUM, TOTAL	UG/L	50 U	4270	
ANTIMONY, DISSOLVED	UG/L	8 U	8 U	
ANTIMONY, TOTAL	UG/L	8 UR	8 UR	
ARSENIC, DISSOLVED	UG/L	1 U	1 U	
ARSENIC, TOTAL	UG/L	1 U	3	
BARIUM, DISSOLVED	UG/L	29.4	47.9	
BARIUM, TOTAL	UG/L	29	86.8	
BERYLLIUM, DISSOLVED	UG/L	1 U	1 U	
BERYLLIUM, TOTAL	UG/L	1 U	1 U	
CADMIUM, DISSOLVED	UG/L	2 U	2 U	
CADMIUM, TOTAL	UG/L	2 U	2 U	
CALCIUM, DISSOLVED	UG/L	25300 J	81300 J	
CALCIUM, TOTAL	UG/L	26100 J	97000 J	
CHROMIUM, DISSOLVED	UG/L	5 U	5 U	
CHROMIUM, TOTAL	UG/L	5 U	8.4	
COBALT, DISSOLVED	UG/L	5 U	5 U	
COBALT, TOTAL	UG/L	5 U	5 U	
COPPER, DISSOLVED	UG/L	5 U	5 U	
COPPER, TOTAL	UG/L	5 U	10.6	
CYANIDE	MG/L	0.005 U	0.005 U	0.0084 U
IRON, DISSOLVED	UG/L	50 U	50 U	
IRON, TOTAL	UG/L	50 U	8530	
LEAD, DISSOLVED	UG/L	1 U	1 UJ	
LEAD, TOTAL	UG/L	1 UJ	7.2 J	
MAGNESIUM, DISSOLVED	UG/L	3800	35400	
MAGNESIUM, TOTAL	UG/L	3550	35900	
MANGANESE, DISSOLVED	UG/L	49.1	6.6	
MANGANESE, TOTAL	UG/L	46.6	117	
MERCURY, DISSOLVED	UG/L	0.2 U	0.2 U	
MERCURY, TOTAL	UG/L	0.2 U	0.2 U	
NICKEL, DISSOLVED	UG/L	20 U	20 U	
NICKEL, TOTAL	UG/L	20 U	20.5	
POTASSIUM, DISSOLVED	UG/L	1000 U	1010	
POTASSIUM, TOTAL	UG/L	1000 U	2580	
SELENIUM, DISSOLVED	UG/L	5 UJ	5 UJ	
SELENIUM, TOTAL	UG/L	5 UJ	5 UJ	
SILVER, DISSOLVED	UG/L	5 U	5 U	
SILVER, TOTAL	UG/L	5 U	5 U	

TABLE C-2.d.1
ORR GROUND WATER SAMPLE RESULTS
1997 SOUTHWEST LAB
RISK ASSESSMENT
NAVSURFWARCENDIV
CRANE, INDIANA

AQUIFER	UNITS	BCH CRK	GOLCON	GOLCON
SAMPLE NAME		06C09	06C16P3	06C16P3,D
INORGANICS, cont.				
SODIUM, DISSOLVED	UG/L	15100	8810	
SODIUM, TOTAL	UG/L	14600	8770	
THALLIUM, DISSOLVED	UG/L	1 U	1 U	
THALLIUM, TOTAL	UG/L	1 U	1 U	
VANADIUM, DISSOLVED	UG/L	5 U	5 U	
VANADIUM, TOTAL	UG/L	5 U	8.8	
ZINC, DISSOLVED	UG/L	5 U	5 U	
ZINC, TOTAL	UG/L	5 UJ	27 UJ	
WATER QUALITY PARAMETER				
ALKALINITY	MG/L	73 J	340 J	15
CHEMICAL OXYGEN DEMAND	MG/L	5 U	5 U	5 U
CHLORIDE	MG/L	3.6	1.4	1 U
NITROGEN (NO2+NO3)	MG/L	2.2	0.035	0.02 U
PH	PH UN	7.3	7.4	6.1
SULFATE	MG/L	17	38	2.5 U
TOTAL DISSOLVED SOLIDS	MG/L	120	370	40 U

APPENDIX 2-5

SUMMARY OF SITE INVESTIGATION DATA

FOR AMMUNITION BURNING GROUND, OLD RIFLE RANGE,

AND DEMOLITION RANGE

4.0 HAZARD IDENTIFICATION

4.1 SITE-SPECIFIC CONCEPTUAL MODEL

The first step in the risk assessment process is hazard identification (NRC, 1983). Hazard identification characterizes in a qualitative manner the potential hazard(s) posed by the project, focusing on the sources and chemicals likely to be responsible for the majority of the risk, the populations most likely to be exposed to these chemicals, and how, where and over what time period this exposure would likely occur. This information is combined to develop various current and future exposure scenarios for the study. These scenarios are then combined to comprise the site-specific conceptual model for the project.

A site visit to NAVSURFWARCENDIV was conducted by project personnel on November 16 and 17, 1992. Based upon the information obtained during this visit, a preliminary conceptual model for this risk assessment was developed. This preliminary model addressed the known chemical release sources for the three SWMUs, the human population(s) that are likely to be the receptors for the project, and the critical exposure routes for the hazardous constituents. A draft risk assessment work plan was then developed and submitted to USEPA for comment.

This preliminary conceptual model was then finalized based on a risk assessment work plan meeting held at the USEPA Region V office in Chicago on August 3, 1994, and through subsequent correspondences. The final risk assessment work plan was submitted in July 1995 (HNUS, 1995); it contained three land use scenarios.

4.1.1 Current Land Use Scenario

Under this land use scenario, the current OB/OD activities at the three SWMUs at NAVSURFWARCENDIV are assumed to continue indefinitely. Under this scenario, three receptor populations were selected for evaluation: base personnel and their families, off-facility residents, and SWMU workers. An extensive inclusion/exclusion analysis was conducted on each of these receptor populations to identify those exposure routes that have the potential to significantly expose these individuals to SWMU-related hazardous constituents. These inclusion/exclusion analyses are presented in Tables 4-1 through 4-3 for these three receptor populations. As a result of this analysis, select exposure pathways were chosen for inclusion in this quantitative risk assessment. These pathways are discussed below and presented schematically in Figure 4-1.

Base personnel and their family members are assumed to (Table 4-1):

a. Be directly exposed to contaminants in the various Facility creeks (surface water and sediment).

b. In the case of the adult individual, be directly exposed to contaminants in surface soil at each of the three SWMUs.

This receptor population is assumed to be composed of adults and children that reside in the on-base housing near Lake Greenwood. One adult in this family is assumed to enter each SWMU on occasion as part of his/her job responsibilities at the base. Adult receptor contact with soil at the SWMUs would involve incidental ingestion and dermal contact. Exposure to contaminants in the various facility creeks by all three members of this family (base worker, spouse, toddler) is assumed to occur via recreational wading (incidental ingestion, dermal contact).

A second receptor population addressed in this current land use scenario is off-facility residents who could become exposed to groundwater contaminants migrating off the base, to contaminants in Facility creeks and area springs, and to contaminants that might have bioaccumulated in wild venison (Table 4-2, Figure 4-1). This off-facility resident population is assumed to be composed of adults and children, and be located

downgradient from ABG. Based on the known life styles of some residents around the facility (i.e. the Padanaram community), this off-facility receptor population is assumed in this analysis to be self-sufficient, i.e. to grow their own garden vegetables, and raise their own beef cattle and dairy cows.

Lastly, because the open burning/open detonation activities are assumed to continue indefinitely, exposure to on-site surface soil contamination at each SWMU could occur by workers in each area (Table 4-3, Figure 4-1). SWMU workers are not assumed to contact the various surface water bodies at the facility in any frequent or repetitive manner, however. At ABG, SWMU workers are also assumed to ingest groundwater and occasionally wash their hands, etc., since a well is present at this site. SWMU workers are also assumed to hunt deer at the facility.

4.1.2 Future Land Use Scenarios

4.1.2.1 Development of NAVSURFWARCENDIV into a Public Park/Natural Area (Figure 4-2)

In this particular future land use scenario, the facility is assumed to cease OB/OD activities at some time in the future (i.e. 100 years) and the land converted into a public park/natural area. Visitors to and employees of this park/natural area would, thus, be expected to come into contact with any environmental medium at each of the three SWMUs that is contaminated, e.g. surface soil, surface water, and sediments in creeks (Table 4-4). Because the facility is turned into a park, drinking water wells could be expected to be installed at each site. Thus, exposure to contaminants in groundwater is also evaluated in this scenario. Park visitors/employees are also assumed to hunt deer on facility property.

4.1.2.2 Development of NAVSURFWARCENDIV into Rural Residential Properties (Figure 4-3)

In this particular future land use scenario, the facility is assumed to cease activities at some time in the future (i.e. 100 years) and the land converted into farming homesteads. Rural residents living on the former SWMUs would be expected to come into direct contact with any environmental medium that is contaminated, e.g. soil, surface water and sediment in creeks, and groundwater beneath the various SWMUs (Table 4-5). Because some of the contaminants at the facility bioaccumulate, this receptor population could also be exposed to contaminants indirectly in home-grown vegetables, wild game (venison), and locally-raised beef and milk (Table 4-5).

4.2 SUMMARY OF SITE INVESTIGATION RESULTS

4.2.1 Historical Database (Appendix A)

4.2.1.1 ABG

Soil

As part of the RFI for ABG, a multi-phased Release Characterization Study (RCS) was conducted by the USACE (Murphy, 1992a). The purpose of this particular study was to identify the nature, degree and extent of hazardous constituents in the soil at this SWMU.

In 1990, the Part I RCS soil samples collected at ABG consisted of 12 borings throughout this SWMU (Figure 4-4). Soil samples were generally taken at the following depth intervals at each boring: 3 to 6 inches, 12 to 18 inches, 18 to 24 inches, 36 to 42 inches, and 6 inches above bedrock. Forty-one (41) soil samples were collected and analyzed for explosives, inorganic chemicals, volatile and semi-volatile organic chemicals, and pesticides/PCBs by the Corps of Engineers laboratory. In general, the contaminants found in the highest concentrations were explosives (2,4-DNT, 2,6-DNT, TNT, Tetryl, DNB, TNB, RDX, and HMX) and metals (Sb, Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn, Al, Co, Mg, Mn, and Sn). Other contaminants found at much lower

concentrations included other inorganics, polycyclic aromatic hydrocarbons (PAHs), volatile organics, and pesticides.

Then, in 1993, an additional 33 surface soil grab samples were taken, along with another 32 soil borings, as part of the Part II RCS (USACE, 1995) (Figure 4-4). Samples from the borings were taken at depths of : 0 to 30 inches, 30 to 60 inches, 60 to 90 inches, and/or at refusal. These Part II RCS soil samples were analyzed for volatile organic chemicals, PAHs, explosives, and inorganic chemicals by the Corps of Engineers laboratory. In this data set, VOCs were detected at several locations, with the highest concentrations associated with cis- and trans-1,2-dichloroethylene and trichloroethylene. Maximum concentrations occurred at the depth range of 30 to 60 inches. In deeper soil, VOCs were detected only in the area of the contaminated burn pads. Several explosives were detected in both surface and subsurface soils. RDX, TNT and HMX were at the highest concentrations. PAHs were also detected in surface and subsurface soil, as were elevated concentrations of cadmium, copper, lead, zinc, and tin.

In preparation for this risk assessment, USEPA conducted a relatively detailed review of select datasets of the historical data for each of the three SWMUs addressed in this study (USEPA, 1997a). After their data validation review was completed, USEPA issued a project memorandum which listed which of the historical data from the various contract laboratories were acceptable for use in this assessment. It was their conclusion that the only historical data acceptable for this risk assessment were: (a) the laboratory data generated by Enseco (now Quanterra), and (b) the explosives data generated by the USACE laboratory. With respect to this medium at the ABG, only the explosive data from the 71 soil sampling locations (Figure 4-4) comprise the historical database.

No historical soil data exist for the Jeep Trail Area.

Surface Water/Sediment

Surface water and sediment sampling in Little Sulphur Creek was also conducted near ABG as part of the RFI that was prepared by USACE (USACE, 1992). The purpose of this sampling was to evaluate the degree and extent of potentially hazardous constituents in surface water and sediments related to past activities at ABG.

Eleven locations were selected by USACE for two sampling events (Figure 4-5). The 11 locations included three background (upstream) samples, three on-SWMU location samples and five locations situated progressively downstream of ABG (and ultimately downstream of the Jeep Trail Area) along Little Sulphur Creek. In general, the samples were analyzed for inorganic and organic constituents, explosives and pesticides/PCBs by the Corps of Engineers laboratory.

The results of the two sampling rounds indicated that potential contaminants were detected less frequently in surface water than in sediment, but that several inorganic constituents (Al, Ba, Mg, Mn, NO_4) were detected at most locations. Three explosives (2,4-DNT, HMX and RDX) were detected in the downstream surface water samples. The greatest frequency of surface water detections, as well as the highest parameter concentrations, occurred in samples ABG-7 and ABG-8, at locations directly downstream of the Jeep Trail Area.

Based on USEPA's data review, the only acceptable historical data for these environmental media are the explosives concentrations, measured in surface water and sediment by the USACE.

Springs

Also as part of the USACE RFI for ABG (Murphy and Wade, 1994a), seven regional springs (Springs A, B, C, D, E, F, Mountain Spring) were sampled for water quality parameters on six occasions (Figure 4-6). One of these springs (Spring A) was sampled an additional seventh time. The springs were sampled in order to

evaluate the potential for groundwater discharge (primarily from the Beech Creek aquifer) to surface water south of ABG and the Jeep Trail Area.

Springs A, B, and C are located along the southern portion of Little Sulphur Creek valley, south of ABG and the Jeep Trail Area. Springs D, E, F and Mountain Spring are located north of ABG. All samples were analyzed for explosives, inorganic chemicals, volatile and semivolatile organic chemicals, and water quality parameters.

Since the RFI, Springs A, B, and C have been sampled four additional times: twice in 1993, once in 1994, and once in 1995.

In general, the contaminants found in samples collected from the springs located south of ABG included TCE, RDX, TNT, and barium. Detections in the northern springs included TCE, di-n-butylphthalate, RDX, mercury and methoxychlor. Because dye tracer studies did not suggest a link between Beech Creek groundwater at ABG and the northern springs, the source of the contaminants detected in the northern springs is not likely ABG.

The acceptable historical spring water database for this assessment includes the explosives data from the USACE 1990 sampling events (seven springs), and a complete dataset (inorganic compounds, explosives, volatile and semi-volatile organic compounds, pesticides) for three springs (Springs A, B, C) obtained in 1994 by Enseco Laboratories.

Groundwater

As part of the RFI for ABG, a multi-phase Groundwater Release Characterization Study was conducted by USACE (Murphy, 1992b). The purpose of this study was to evaluate the hydrogeology and the degree and extent of chemical release to groundwater at ABG. A total of 98 monitoring wells exist at ABG. Seventy-one (71) of these wells have been sampled on a semi-frequent basis since 1987. Analytical parameters selected were referred to as RCRA Group 1 parameters, RCRA Group 2 parameters, RCRA Group 3 parameters, explosives, organics, and PCBs (see RAWP for list of chemicals included in each group).

The four main aquifers and/or geologic units at ABG are (from the deepest to the shallowest):

- Beaver Bend limestone.
- Big Clifty sandstone/Beech Creek limestone.
- Golconda limestone.
- Alluvium.

With respect to the existing data, it appears that the Beech Creek aquifer is the most significantly impacted groundwater at ABG. It is also the most important hydrogeological unit in terms of off-site migration of contaminated groundwater. Consistently detected contaminants included: TCE, RDX, and barium.

Below is a summary of the historical data for each aquifer/geologic unit.

(a) Beaver Bend

The Beaver Bend aquifer is the deepest groundwater unit that is currently monitored at ABG. All five of the existing wells screened in this unit are on-SWMU (Figure 4-7). Beaver Bend sampling has occurred over an eight-year period.

TCE has been detected in this aquifer on several occasions in most of these wells. The greatest number of reported TCE detections (and the highest level) occurs in well 03C09 (1-20 μg/L) prior to 1992, located north of the main activity area and upgradient from the SWMU. RDX was also reported in this well at 230 μg/L.

Based on USEPA's data review, the only valid historical sampling and analysis data for this medium are the 1993 databases obtained by Enseco (three wells: 03C03, 03C08A, 03C09).

(b) Beech Creek

This groundwater unit has the majority of the wells at ABG screened in it. For the purposes of this risk assessment, the Beech Creek aquifer monitoring wells were grouped by general location relative to ABG. These nine groups are as follows:

On-SWMU (Figure 4-8)

North-Northwest Corner:	03C16, 03C09P2
Western Third:	03C14, 03C10, 03C01P2, 03C20, 03C21
Eastern Two-thirds:	03C03P2, 03C11, 03C04, 03C06, 03C07, 03C08AP2, 03-04, 03-06, 03-35, 03-37, 03C02P2, 03C12, 03C27, 03-36

Off-SWMU (Figures 4-8 through 4-14)

Jeep Trail/Little Sulphur Creek:	03-10, 03-11, 03-12, 03-13, 03-14, 03-15, 03-16, 03-17, 03-18, 03-20, 03-21, 03-22, 03-23, 03-24, 03-25
Downgradient Perimeter/ Little Sulphur Creek:	03C37, 03B10, 03C38
Downgradient East/Southeast:	03C28, 03C05, 03C34, 03C35, 03C36
Downgradient Southwest:	03C15, 03C24, 03C25, 03C29, 03C30, 03C31, 03C33
Upgradient North:	03C26, 03C13, 03C17, 03C19, 03C32
Northeast:	02C10, 02C11, 02C12, 02C14, 02C20, 02C22

The North-Northwest Corner group is upgradient to ABG. The Western Third group includes the wells located in the area which is overlain by the Indian Springs Shale member of the Big Clifty Formation. The Eastern two-thirds group includes the wells along the valley axis where the Indian Springs shale is absent. Sampling and analyses of all of these wells has been conducted frequently since 1987.

Well 03C09P2 is located on the upgradient side of ABG. Historically, the highest TCE levels have been detected in this well for this side of the site. TCE has been detected consistently at concentrations of 51-136 μg/L. In addition, the explosive RDX has been frequently detected in this well, at levels of 20-70 μg/L.

Five wells located on-site seem to be the most representative of groundwater quality beneath the eastern two-thirds of ABG:

- 03C03P2
- 03C08AP2
- 03C11
- 03C20
- 03C02P2

Well 03C03P2 has demonstrated persistent and elevated detections of TCE (usually above 100 μg/L). Three explosives have also been detected in this well, including the highest RDX concentrations on-site (709 μg/L). Well 03C11 has demonstrated the second highest TCE detections after 03C20. Well 03C02P2 is located in

the eastern-most portion of ABG, in an area believed to be characterized by a high gradient, high-flow velocity Karst conduit system. TCE and RDX have been consistently detected in this well, but at low concentrations.

Based on USEPA's data review, the historical database for this medium is comprised of data from the one 1993 sampling event conducted by Enseco (23 wells).

(c) Big Clifty

A limited number of Big Clifty wells are present at ABG (Figure 4-15). For some of these wells, the screened interval apparently includes the contact zone with the underlying Beech Creek limestone. Sampling and analyses of these wells has occurred since 1987.

TCE has been consistently detected in several of these Big Clifty wells. RDX has also been detected on multiple occasions. As these wells are screened in the same unit as the Beech Creek wells, no separate database was developed for this risk assessment. Data from these wells are included with data from the Beech Creek wells.

(d) Golconda

The Golconda limestone occurs near the northern, southern and western edges of ABG. This unit has been removed by erosional processes in the central portions of ABG and in the valleys of Little Sulphur Creek and Johnson Hollow.

Historical findings exist for all of the Golconda wells at ABG and for the three off-SWMU wells (Figure 4-16), but none of these data were viewed as acceptable for this risk assessment. TCE has been detected on multiple occasions in this unit, especially at well 03C22 (maximum = 300 μg/L).

(e) Alluvial Wells

All but one of these wells are located south of ABG and the Jeep Trail Area, at the confluence of Little Sulphur Creek and Johnson Hollow (Figure 4-17). The Jeep Trail Area has one alluvial well (03-07; Figure 4-18). As previously noted by USACE (Murphy and Wade, 1994a), groundwater from ABG (primarily within the Beech Creek aquifer) discharges downgradient to springs and to the Little Sulphur Creek alluvium. Therefore, these wells are used to monitor potential impacts to surficial groundwater at the facility boundary. These wells have been routinely sampled from 1987 to 1992. Since 1992, only a few select wells have been sampled.

The acceptable analytical database for this medium includes the single well sample (03B02) obtained in 1993 by Enseco.

4.2.1.2 ORR

Soil

ORR is the other NAVSURFWARCENDIV open burning area (besides ABG). Flashing is carried out at this site in flash pits. The USACE conducted an RFI soil investigation at ORR (Murphy and Wade, 1994b) to: 1) describe the soil conditions at this SWMU, 2) identify and characterize the flashing residuals, and 3) determine if residues have impacted the environment around the flash pits.

As part of the RFI, twelve (12) test borings were advanced at the ORR in 1990 to collect soil samples for physical characterization and chemical pollutant identification (Figure 4-19). Soil samples were taken from specific layers within the borings; 0.2 to 0.5 feet bgs, 3 to 6 feet bgs, 12 to 18 feet bgs, and within 6 feet of the groundwater table. These samples were analyzed for explosives, inorganic compounds, volatile and semivolatile organic compounds.

Some explosive compounds were detected in soil within the flash pits and in nearby areas. ORR soil also contained several VOCs.

As all of these samples were analyzed by the USACE laboratory, only the explosives data were judged to be acceptable for use in this assessment.

Surface Water/Sediment

No historical data exist for Turkey Creek.

Groundwater

A hydrogeologic investigation was also conducted by USACE as part of the ORR RFI (Murphy and Wade, 1994b). The purpose of this investigation was to evaluate subsurface conditions at this SWMU with respect to the degree and extent of chemical releases to groundwater from past ORR activities.

Eleven (11) monitoring wells were installed at ORR by USACE in 1982-1984. An additional 19 monitoring wells were installed in 1990. USACE sampled 28 of these wells in four consecutive events in 1991-1992 for the RFI. The analytical parameter list included explosives, inorganic chemicals, volatile and semi-volatile organic chemicals, and pesticides/PCBs.

For the purposes of this risk assessment, the ORR monitoring wells were grouped according to the formation in which they were screened. These groups were:

- Beech Creek limestone (10 wells; Figure 4-20).
- Golconda limestone (2 wells, Figure 4-21).
- Surficial aquifer (16 wells; Figure 4-22).

In general, contaminants detected in groundwater at ORR included metals (in both the Beech Creek limestone and the surficial zone), explosives and nitrate.

With respect to groundwater at ORR, the acceptable historical database includes:

Beech Creek Aquifer

- 1991,2 USACE data (10 wells; explosives data only)
- 1993 Enseco data (7 wells)

Golconda Aquifer

- 1990,1,2 USACE data (2 wells; explosives data only)

Surficial Aquifer

- 1991,2 USACE data (16 wells; explosives data only)
- 1993 Enseco data (4 wells)

4.2.1.3 DR

DR is the primary open detonation area at NAVSURFWARCENDIV. Two separate areas within this SWMU are used to detonate materials. The south ridge is used exclusively by CAAA, while the east ridge is used by the Navy. The majority of detonation activities occurs at the south ridge area.

Soil

No historical data exist for soil at DR in either detonation area.

Surface Water/Sediment

No historical data exist for Boggs Creek.

Groundwater

As part of the USACE's RFI for DR (Murphy and Wade, 1994b), a hydrogeologic investigation was conducted to evaluate subsurface conditions, and the degree and extent of chemical release to groundwater, at DR.

Fifteen (15) monitoring wells were installed at DR in 1982, and an additional 14 wells were installed in 1989. USACE sampled 17 of these wells for four consecutive quarterly events in 1992 for the RFI. Wells excluded from the program were the seven wells in the Mansfield Formation located in the southern portion of DR (06-02, 06-03, 06-04, 06-05, 06-09, -6-10, 06-11). For the wells sampled, the analytical parameter list included explosives, inorganic chemicals, volatile and semi-volatile organic chemicals, and pesticides/PCBs.

These wells are also grouped according to the geologic unit in which they are screened. These groups were:

- Beech Creek limestone (8 wells; Figure 4-23).
- Intermediate Zone (1 well; Figure 4-24).
- Surficial Zone (19 wells; Figure 4-25).

In general, the contaminants detected in groundwater at DR were metals (some of which were above MCLs).

With respect to groundwater at DR, the only acceptable analytical data for use in this risk assessment includes:

Beech Creek Aquifer

- 1990,1 USACE data (8 wells; explosives data only)
- 1993 Enseco data (7 wells)

Surficial Aquifer

- 1990,1 USACE data (10 wells; explosives data only)
- 1993 Enseco data (4 wells)

The one well screened in the intermediate zone at this SWMU has always been dry at the time of the past sampling events. Therefore, no historical data exist for this unit at DR.

4.2.1.4 Background Sampling

Soil

(a) ABG

During the Part 1 RFI Phase III Soils Investigation at ABG, three borings were installed in background locations in the southwest portion of the site (borings 01, 02, and 03; see Figure 4-4). The Corps of Engineers laboratory did the sample analyses. No explosives, VOCs, or SVOC were detected in soil samples from these borings. Several pesticides were detected, but their presence was interpreted to be related to general use

of pesticides in the area rather than ABG-specific activities. These samples were therefore considered at that time to be acceptable for use as ABG soil background.

However, none of the data from these samples were judged to be acceptable for use in this risk assessment. Therefore, no historical background soil data exist for ABG.

(b) ORR

Soil samples collected from "control" locations during the 1990 soils investigation contained the highest levels of some metals of all samples collected at the ORR. There was some question, therefore, as to whether or not these samples were truly representative of background conditions at the site. For this reason, it was concluded at the time of the RAWP that no historical background soil existed for the ORR.

(c) DR

No historical background soil data exist for DR.

Surface Water/Sediment

(a) ABG

Three background locations (upstream from ABG) were selected for collection of surface water and sediment samples by USACE in 1992 (Figure 4-15; locations 1 through 3). Two rounds of samples were analyzed for VOCs, SVOCs, metals, and explosives. Only the second round of samples was analyzed for pesticides/PCBs.

Based on the data validation memorandum issued by USEPA, only the explosives data from these six samples (three surface water; three sediment) are acceptable for use in this assessment. However, since explosives were detected within these samples, none of them are considered background samples in this risk assessment. These samples will be treated as site data.

(b) ORR/DR

No historical background surface water or sediment data exist for either Turkey Creek or Boggs Creek.

Groundwater

(a) ABG

For the Beaver Bend aquifer (Figure 4-7), two existing wells are potential candidate background wells - 03C01 (which is side-gradient to ABG) and 03C09 (which is upgradient to ABG). Both of these wells, however, have exhibited contamination in the past, particularly explosives and volatile organic compounds. Therefore, neither well qualifies as a background well for risk assessment purposes.

For the Beech Creek aquifer, three existing wells are potential background wells - 03C17 (Figure 4-13; upgradient to ABG), 03C09P2 (Figure 4-8; upgradient to ABG), and 03C07 (Figure 4-8; side-gradient to ABG). Two of these wells (03C09P2 and 03C07) have been found to be contaminated with explosives, volatile and semi-volatile organic chemicals in the past. These wells, therefore, do not quality as background wells for risk assessment purposes. Well 03C17 has never shown explosives, volatile or semi-volatile chemical contamination. The inorganic concentrations detected are therefore likely to be naturally occurring. Thus, this well does serve as a background water sample for the Beech Creek aquifer at ABG. Valid Enseco data (1993) exist for this well.

For the Big Clifty aquifer (Figure 4-15), four existing wells are potential candidate background wells - 03-09, 03-38, 03-01 and 03-30 (all upgradient to ABG). Three of these four wells (03-09, 03-38 and 03-01), however, have shown past contamination by explosives and volatile organic chemicals. Well 03-30, although it has been sampled, has never had a sample analyzed for explosives, volatile and semi-volatile organic contaminants. Thus, none of these four wells currently qualify as a background well for the Big Clifty aquifer at ABG. However, since the Big Clifty aquifer and the Beech Creek aquifer are in direct contact, the Beech Creek background well (03C17) can serve as background for this aquifer as well.

For the Golconda aquifer (Figure 4-16), five existing wells are potential candidate background wells - 03C18, 03-02, 03C15P3, 03C16, 03C19P3 (all upgradient to ABG). Only one of these wells, 03C16, has a past history of contaminant detections. Well 03-02, however, has not been monitored. Both of these wells thus do not meet the qualification of background wells for the risk assessment of this site. The other three wells, 03C19P3, 03C15P3, 03C18, can serve as the background locations for this aquifer; however, valid data exist for only one of these wells (03C19P3).

All of the monitoring wells except one in the alluvium unit associated with ABG are located at the juncture of Little Sulphur Creek and Johnson Hollow (Figure 4-17). The other well is located directly adjacent to and downgradient from the Jeep Trail Area (Figure 4-18). None of these wells therefore can be considered background wells, and nowhere on the facility is there a location that could serve as a background sampling location for this unit.

(b) ORR

As discussed earlier, the U.S Army Corps of Engineers conducted an RFI at ORR which included the sampling of groundwater at 28 locations at this SWMU (Figures 4-20 through 4-22). The analytical parameter list utilized at this site included explosives, inorganic chemicals, volatile and semi-volatile organic chemicals, and pesticides.

For each of the three units at this SWMU (Beech Creek limestone, Golconda limestone, surficial aquifer), the 06C16 well nest (three wells) is situated upgradient of this SWMU, and thus the data can serve as background.

Since the USACE laboratory conducted all of the past analyses on these wells; however, only the explosives data are acceptable for use in this assessment. Thus, no historical inorganic background groundwater data are available for this risk assessment.

(c) DR

As discussed earlier, the U.S. Army Corps of Engineers conducted an RFI at DR which included the sampling of groundwater at 17 well locations at this SWMU (Figures 4-23 through 4-25).

These wells are grouped according to the geologic unit in which they were screened. These three groupings were:

- Beech Creek limestone.
- Intermediate Zone.
- Surficial Zone.

For the Beech Creek and surficial zone aquifers, the 06C08 well nest (two wells) is situated upgradient of this SWMU and thus the data could serve as background. Historical data from these wells have shown them to be clean; however, these data were not viewed as acceptable for use in this risk assessment by the USEPA.

4.2.2 Supplemental Risk Assessment Analytical Databases (Appendices B and C)

As discussed in the prior section, there exist considerable historical data for the three SWMUs at this facility. In 1994, in preparation of the RAWP, HNUS reviewed these historical databases for these three SWMUs and made recommendations for the collection of minimal supplemental data in order to complete the databases desired for the risk assessment. These supplemental data were collected in 1995-1996 using Southwest Laboratories (Appendix B).

Unfortunately, however, much of the historical data (pre-1995) were collected through programs which did not require independent data validation. Thus, most of these data had never undergone data validation to the extent necessary for use in a risk assessment. USEPA reviewed select data packages from these historical databases in 1997 and concluded that much of these data could not be used for this risk assessment due to a lack of QC package information. USEPA did conclude, however, that all of the HNUS team's 1995-6 sampling and analysis program data were acceptable for use in this assessment.

Subsequent to the USEPA (1997a) data validation technical memorandum, the HNUS team collected a second round of supplemental data for this risk assessment to again "fill in datagaps" in the databases for this risk assessment. These data were independently validated. These data are listed as HNUS, 1997 (Appendix C).

Appendix D describes the sampling and analysis program that was used by the HNUS team in both supplemental sampling programs (1995-6 and 1997) at NAVSURFWARCENDIV.

Below is a summary of these two supplemental risk assessment databases for each environmental media at these three SWMUs.

4.2.2.1 ABG

Soil

It was noted at the time of the original review of the historical ABG soil data (in 1993) that none of the soil samples previously collected at ABG by USACE were analyzed for chlorinated dioxins and furans (PCDD/PCDF), and that no soil samples had been collected from the Jeep Trail Area. HNUS, therefore, collected three surface soil samples in 1995 from around the burn pans and pads and analyzed these samples for PCDD/PCDF (Figure 4-26). Five surface samples were also collected at that time from the Jeep Trail Area (Figure 4-27). These latter samples were analyzed for explosives, inorganic chemicals and semi-volatile organic chemicals.

As a consequence of the data validation findings on the historical data for this medium, HNUS collected another round of supplemental surface and subsurface soil samples in 1997. Twenty-one (21) surface soil samples were collected, along with five subsurface soil samples from three locations. These samples were taken from the following previous sampling locations (see Figure 4-26).

1990	Boring 4 - surface, subsurface	1993	Boring 17 - surface
1990	Boring 7 - surface	1993	Boring 19 - surface
1990	Boring 12 - surface, subsurface	1993	Boring 22 - surface, subsurface
1993	Boring 1 - surface	1993	Boring 25 - surface
1993	Boring 2 - surface	1993	Boring 31 - surface
1993	Boring 3 - surface	1993	Boring 33 - surface
1993	Boring 5 - surface	1993	Boring 37 - surface
1993	Boring 6 - surface	1993	Surface 39 - surface
1993	Boring 7 - surface	1993	Surface 40 - surface
1993	Boring 13 - surface	1993	Surface 61 - surface

1993 Boring 14 - surface

All samples were analyzed for inorganic chemicals, with seven samples analyzed for semi-volatile and volatile organic compounds and pesticides. Sample-specific parameter lists were determined based on past reported data.

Surface Water/Sediment (Little Sulphur Creek)

Based on the original review of the historical data by the HNUS team (1993), several new sampling locations along Little Sulphur Creek were recommended for sampling, to specifically address potential impacts near the Jeep Trail Area. These two sampling locations are designated ABG-12 and ABG-13 on Figure 4-28. In addition, three other upstream background samples were taken for this risk assessment. These locations are designated ABG-1, ABG-14 and ABG-15 on Figure 4-28. All samples were analyzed for inorganic chemicals, volatile and semi-volatile organic chemicals, explosives and pesticides.

As a consequence of the data validation findings on the historical data for these media, HNUS collected four supplemental surface water and sediment samples in 1997 from Little Sulphur Creek. These samples were taken at the previous sampling locations: ABG-8, ABG-11, ABG-5 and ABG-6 (Figure 4-28). All samples were analyzed for metals, three for pesticides, and two for volatile and semi-volatile organic chemicals. All sediment samples were also analyzed for explosives.

Springs

Based on the original review of this historical data by the HNUS team (in 1993), a number of these springs were recommended for additional sampling for select parameters. Spring A (Figure 4-29) was selected for sampling for inorganic chemicals, volatile and semi-volatile organic chemicals and explosives. Springs B and C were selected for sampling for metals, cyanide, semi-volatile organic compounds and explosives. In addition, two off-Facility springs (Springs 8 and 10) were selected for sampling for inorganic chemicals, explosives, volatile and semi-volatile organic chemicals and pesticides/PCBs.

No additional (1997) supplemental sampling of springs was necessary as a consequence of the USEPA (1997a) data validation memorandum.

Groundwater

Based on the original review of the historical ABG groundwater data by the HNUS team (in 1993), recommendations were made to supplement the existing data. These recommendations included sampling of:

Beaver Bend:	No wells
Beech Creek:	03C17 (Figure 4-13; upgradient), and each existing Jeep Trail well that exhibited integrity (Figure 4-9)
Big Clifty:	No wells
Golconda:	No wells
Alluvial Wells:	No wells

As a consequence of the data validation findings on the historical data for this medium, HNUS collected an additional eleven supplemental groundwater samples in 1997. The aquifers and locations of these ten samples are:

Beaver Bend:	03C01 (Figure 4-7)
Beech Creek/ Big Clifty:	03C15, 03-16, 03-21, 03-13, 03C20 (Figures 4-8 and 4-9)

Golconda: 03C23, 03C08AP3, 03C19P3 (Figure 4-16)
Alluvial Wells: 03B05, 03B07 (Figure 4-17)

All but one sample were analyzed for explosives. Five samples were analyzed for metals, four for volatile organic chemicals, and two for semi-volatile organic chemicals and pesticides.

4.2.2.2 ORR

Soil

Based on the original review of this historical data by the HNUS team (in 1993), it was recommended that some additional soil samples be collected at ORR for this risk assessment. Specifically, three surface soil samples (0-2 feet bgs) were recommended for collection in the target practice area and analyzed for lead (see Figure 4-30). Also, three new background surface soil samples were recommended for collection (see Figure 4-30). All six samples were collected in 1995 and analyzed for inorganic chemicals, explosives and semi-volatile organic chemicals.

As a consequence of the data validation findings on the historical data for this medium, HNUS collected four additional surface soil samples and two additional subsurface soil samples at ORR. The locations of these 1997 supplemental samples are shown on Figure 4-80.

1990	Boring 1 - surface
1990	Boring 5 - surface, subsurface
1990	Boring 9 - surface
1990	Boring 12 - surface, subsurface

All of these samples were analyzed for metals, with two analyzed for pesticides and one for volatile and semi-volatile organic chemicals.

Surface Water/Sediment (Turkey Creek)

The database for these two media at ORR consists of samples taken in 1995 at two downstream locations and one upstream location on Turkey Creek, as shown on Figure 4-31. The analytical parameters measured in these samples included inorganic chemicals, volatile and semi-volatile organic chemicals, and explosives. All of these data were judged to be acceptable for use in this risk assessment by USEPA. Thus, no 1997 supplemental data were collected from this medium for this risk assessment.

Groundwater

Based on the original review of the groundwater historical data by the HNUS team (in 1993), seven monitoring wells at ORR were recommended for sampling for this risk assessment. These wells are: 06C16, 06C12, 06C18, 06C16P2, 06-17, 06-22, 06C18P2 (Figures 4-20 and 4-22). In addition, two new wells were installed and sampled in 1995. These new wells are designated 06C19 wells (see Figures 4-20 and 4-22). The analytical parameters measured in these samples included volatile and semi-volatile organic chemicals, inorganic chemicals, and explosives.

As a consequence of the data validation findings on the historical data for these aquifers, HNUS collected two additional groundwater samples in 1997. These samples were from wells 06C09 (Figure 4-20) and 06C16P3 (Figure 4-21). Both samples were analyzed for metals. A sample was recommended from Well 06-21 (Figure 4-21), but this well was dry.

4.2.2.3 DR

Soil

The database for this medium at DR consists of eight surface soil composite samples (0-2 bgs) collected at the Army Detonation Area (south ridge) and three surface soil composite samples collected at the Navy Detonation Area (east ridge) in 1995 by the HNUS team (Figure 4-32). In addition, three background surface soil samples were taken at that time. All samples were analyzed for explosives, inorganic chemicals and semi-volatile organic chemicals. All of these data were judged to be acceptable for use in this risk assessment by USEPA, and thus no additional data were collected for this medium in 1997.

Surface Water/Sediment (Boggs Creek)

The database for these two media at DR consists of samples taken at two downstream locations and one upstream location on Boggs Creek (see Figure 4-31). The analytical parameters measured in these samples included inorganic chemicals, volatile and semi-volatile organic chemicals and explosives. All of these data were judged to be acceptable for use in this risk assessment by USEPA, and thus no additional data were collected for this medium in 1997.

Groundwater

Based on the original review of the groundwater historical data at DR by the HNUS team (1993), ten monitoring wells were recommended for sampling for this risk assessment. These wells were (see Figure 4-23 and 4-25):

Beech Creek:	06C01, 06C03, 06C06, 06C07
Surficial Zone:	06-01A, 06-07, 06C03P2, 06C04P2, 06C06P2, 06C08P2

All of these data were judged to be acceptable for use in this risk assessment by USEPA, and thus no additional data were collected for these media in 1997.

4.3 DATA ASSEMBLY

The analytical databases obtained for this risk assessment are a composite of three distinct sampling programs, denoted as:

- Validated historical data.
- HNUS 1995-6 supplemental sampling data.
- HNUS 1997 supplemental sampling data.

The entire data sets for these three programs are provided in Appendices A, B, and C.

In this section, these data are combined and summarized according to environmental medium/source area.

Data assembly involves grouping the data by environmental medium (e.g. soil, groundwater) and within a medium by distinct areas of concern (e.g. Jeep Trail Area soils). Statistical procedures are then performed to summarize the data for use in the risk assessment.

The distributional properties of the various data sets are first tested in order to apply the appropriate statistical tests and for proper interpretation of the results. A test of normality, the Shapiro-Wilk Test, was applied to data from each of the various media investigated in this risk assessment, if at least four samples were available. Probability plots were used to assess data distribution if the sample number exceeded 50.

The data summary tables include the following information: frequency of detection, range of detected values, range of reporting limits, average concentration, 95 percent upper confidence limit (UCL) of the mean, and the exposure point concentration. According to USEPA guidance (USEPA, 1989a), the exposure point concentration is the 95 percent UCL value, or the maximum detected value, whichever is lower.

If the data were determined to have a lognormal distribution, the average concentration in the tables is the MVU estimate of the mean (Minimum Variance Unbiased estimator, Gilbert, 1987). The 95 percent UCL values for normal and lognormally distributed data sets were calculated according to USEPA guidance (1992b)

For this statistical analysis of the data, duplicate sample data, when available, were averaged. When a chemical was detected in only one of two duplicate samples, only the detected concentration was used. Samples collected at different times at the same sample location (e.g., well samples, surface water samples) were treated as duplicates.

One-half of the SQL was used in the calculations for all SQLs remaining in each data set (USEPA, 1989a).

4.4 IDENTIFICATION OF THE CHEMICALS OF POTENTIAL CONCERN (COPCs)

Once the data have been properly assembled, the chemicals of potential concern (COPCs) for the project are selected. A COPC is a chemical that has been selected for evaluation in the study. It is defined as an analyte that has been detected in at least one environmental medium at a site and that:

- Exceeds its natural background levels.
- Is not considered an artifact of the sampling or analysis program(s).

Chemicals of potential concern to a project, therefore, are not necessarily chemicals which will produce significant risk to public health or the environment. Rather, these are the analytes believed to be present at elevated concentrations at the site.

The objective of this step in the study is to identify the various media-specific COPCs for each of these three SWMUs. The data set that is used to determine the project specific COPCs is the composite data set of the three sampling programs discussed earlier.

4.4.1 Procedure

The COPC selection process discussed below follows US EPA guidance (1989a). Details of this COPC selection process are provided in Appendix E.

Step 1: The first step in the process is to review the individual SWMU- and medium-specific data sets for qualified data, and conduct a comparison of sample results to blank results. Any result that has been coded 'R' was eliminated from the data set; 'J' coded data were retained. For those analytes that were present in blank samples, USEPA's 5/10 rule was applied. If a blank contained detectable concentrations of a common laboratory contaminant (acetone, 2-butanone, methylene chloride, toluene and the phthalate esters), then a sample result was only considered positive if the concentration in the sample exceeded ten times the maximum amount detected in its associated blank. If a blank contained detectable concentrations of one or more other organic or inorganic chemicals, then the site sample result was considered positive if its analyte concentration was greater than five times the maximum blank concentration.

Step 2: Background Screening
In this step, the concentrations of detected chemicals in site soil, sediment, surface water and groundwater were compared to the concentrations of these analytes in the respective SWMU-specific background samples. For soil, two comparisons were made where applicable: 1) surface soil, and 2) Surface/subsurface soil combined. Both comparisons were made using the surface soil background data since no subsurface soil background samples were available.

Soil

Because the number of soil background samples for any SWMU did not exceed three, background threshold values of inorganics were calculated as the average concentration plus two times the standard deviation. Appendix E, Tables E-1 through E-3 summarize the calculation of the background threshold values for soil at ABG, ORR, and DR. It should be noted that one of the three background soil samples for the DR had several hits of PAHs and higher concentrations of most of the inorganics than the other two samples. This sample was considered to be possibly contaminated and was therefore not used to calculate the soil background threshold value for the DR.

If the concentration of an inorganic compound in any sample at a site exceeded its background screening threshold, that inorganic constituent was retained and carried through the risk assessment. If all soil samples collected at a site had concentrations that were lower than the background screening threshold, the inorganic was considered to be present in concentrations consistent with background and was eliminated as a chemical of potential concern. If an inorganic constituent was not analyzed for or not detected in background samples, the constituent was assumed to be site-related and carried through the risk assessment. As mentioned, surface soil and surface/subsurface soil combined were screened separately, if applicable. Tables E-6 through E-12, Appendix E, document the background screening for soil at ABG, ORR, and DR.

No background soil samples were analyzed for dioxins. Because chlorinated dioxins and furans are frequently encountered in the environment as anthropogenic background, the profiles of the congeners within the three individual samples collected at ABG were examined. In general, the lower chlorinated congeners degrade quickly in the environment, leaving behind the higher chlorinated congeners which can persist for hundreds of years (Bumb *et al.*, 1980; Nestrick *et al.*, 1986; Smith *et al.*, 1983). For comparison purposes, bar graphs, which are presented in Appendix E, Figure E-1, were constructed using *total* concentrations of each of the various congeners within a sample. The graphs are presented only to illustrate the overall pattern of the congener distribution within the samples, not to compare total dioxins/furan concentrations among the samples. The figure shows that the congener pattern in the samples have the typical pattern associated with background anthropogenic dioxins/furans. This may indicate that the dioxins/furans detected in the soils at APG are not site-related.

Groundwater

The background data set did not exceed one sample for any aquifer evaluated in the risk assessment. Therefore, direct comparisons were made between a single background concentration of an analyte and the aquifer-specific sample data. If an aquifer sample contained an analyte at a concentration greater than its concentration in the appropriate background sample, or an inorganic constituent was not analyzed for or detected in background samples, then that analyte was considered a contaminant. Tables E-13 through E-18, Appendix E, document the background screening for groundwater at ABG, ORR, and DR.

No background samples were available for the Beaver Bend and Alluvial aquifers at ABG. In addition, 2,4,6-trichlorophenol, xylene, and two phthalate esters were detected during the most recent sampling event at the background well for the Alluvial aquifer at the DR. This well was considered to be possibly contaminated and therefore the sample data were not used for background comparison.

Surface Water/Sediment

Three surface water and three sediment background samples were collected from Little Sulphur Creek at ABG. One of the surface water samples (ABG-14) contained xylene and was therefore considered to be possibly contaminated. This sample was not used in the calculation of a background threshold value for Little Sulphur Creek surface water. Tables E-4 and E-5, Appendix E, summarize the calculation of the background threshold values for Little Sulphur Creek surface water and sediment, respectively. For Turkey Creek and Boggs Creek, only one background sample each was collected for surface water and sediment. Therefore, the background comparison for both surface water and sediment in these two creeks consisted of comparing the highest detected concentration downstream with the single upstream sample. Tables E-19 through E-24, Appendix E, summarize the background screening for surface water and sediment for Little Sulphur Creek, Turkey Creek, and Boggs Creek. No background samples were available for the springs.

Step 3: Frequency of Detection/Nutrient Screening
In this step, the concentrations of nutrients detected above background levels in site soil, sediment, surface water, and groundwater were compared to nutrient screening values, which were derived according to the procedures described below. For soil, two separate data sets were screened: (1) data for nutrient chemicals detected in surface soil above background; and, (2) analytical results representing surface soil data combined with subsurface data for all nutrients detected above background in either surface or subsurface soil. This approach for soil was used to accommodate the future residential exposure scenario selected in the conceptual site models (presented in Section 4.1).

For the risk assessment, nutrient screening values were calculated for nutrients detected in the soil, sediment, and surface water, and groundwater databases without USEPA toxicity values (i.e., calcium, magnesium, iron, potassium, and sodium). The nutrient screening values were calculated using CERCLA guidance for the deviation of preliminary soil or drinking water remediation goals (PRGs) for a residential scenario (USEPA, 1991a). The U.S. recommended daily allowance (RDA) was substituted for the toxicity value in the equation, and the target hazard quotient was 1.0. The RDAs were taken from Region VIII guidance (USEPA, 1994a). In those instances where the calculated nutrient screening value exceeds 1E+06 ppm (calcium, magnesium, and sodium), the value of 1E+06 ppm was used as the screening value.

Since an RDA was not provided for sodium (Na^+), a review of the medical literature was conducted by REI to determine an acceptable level of human consumption for this nutrient. Uncomplicated hypertensive patients should not consume more than 4 to 6 grams of salt (1,600 to 2,400 mg Na^+) per day (Rakel, 1990; Wyngaarden *et al.*, 1992). The value of 1,600 mg Na^+ of salt per day was therefore selected as a safe human consumption level. Assuming an adult body weight of 70 kilograms (kg), a safe dose for sodium is estimated at approximately 20 milligrams per kilogram per day (mg/kg-day).

Table 4-6 summarizes the calculated nutrient screening values used in this risk assessment. The exposure point concentration of each nutrient (i.e., the 95 percent UCL of the mean or the highest detected concentration, whichever is lower; USEPA, 1989a) was compared to the screening value. Tables E-25 through E-30, Appendix E, document the nutrient screening for soil, sediment, surface water, groundwater, and springs.

The exposure point concentrations for the five nutrients were lower than their respective nutrient screening values in all media except groundwater. As shown in Tables E-28, the concentrations of magnesium, iron, and potassium exceeded their screening values in the Alluvium at ABG. Iron exceeded its screening value in all aquifers where it was detected above background, with the exception of the Alluvium at the Army DR (Tables E-28 and E-29). It should be noted that the exceedances indicate only that the recommended daily allowances have been exceeded. If concentrations do not exceed the screening values one can be fairly certain that humans would not suffer adverse effects due to exposure. When these values are exceeded, toxic effects may occur, but not necessarily.

Chemicals that are infrequently detected at a site may be sampling or analytical artifacts unrelated to site operations. Such chemicals may be eliminated from the quantitative risk assessment if there is no reason to believe that the chemical may be present (USEPA, 1989a). For this risk assessment, the criteria for a chemical to be eliminated from the chemical database were: it was detected in 5 percent or fewer of the samples and the history of the site suggests that it would not be expected to be present.

The criterion of detection in fewer than 5 percent of samples limited the frequency of detection analysis to soil at ABG, since this was the only medium for which 20 or more samples were collected. The only chemical detected in fewer than 5 percent of samples was 1,3-dinitrobenzene. This compound was expected to be present in soils at ABG; therefore, it was retained for evaluation in the risk assessment.

4.4.2 SWMU-specific COPCs

4.4.2.1 ABG

Soil

Shown in Table 4-7 are the summary data for surface soil (0-2 feet bgs) at the ABG proper. Semi-volatile organic chemicals (SVOC), explosives, polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans, and inorganic chemicals comprise this database. Consistent with the historical data, the compounds detected at the highest concentrations are explosives (TNT, RDX, HMX) and metals (Al, Ba, Cu, Pb, Mn, Ag and Zn). All of these contaminants are also found at a relatively high frequency of detection (40 to 100 percent). Other contaminants found at less concentrations, but high frequency, are metals (As, Cr, Co, Ni, Sb and V) and 4-amino-2,6-dinitrotoluene.

In Table 4-8 are summary data for surface soil at the Jeep Trail. Contaminants detected at the highest concentrations in this area include metals (Al, Ba, Zn). Lesser amounts of 2,4-DNT, copper, nickel and di-n-butylphthalate were also found. Each of these contaminants were also found at relative high frequency (60 to 100 percent).

Table 4-9 presents summary data for the ABG proper for combined surface and subsurface soil. As with the surface soil dataset, the contaminants detected at the highest concentrations include explosives (2,4,6-TNT, HMX, RDX) and metals (Al, Ba, Cu, Pb, Mn, Ag, and Zn). Lesser amounts of other explosives and metals were also found. Two SVOCs [bis(2-ethylhexyl)phthalate, di-n-butylphthalate] were detected, as was one volatile organic compound (acetone).

Surface Water/Sediment

Table 4-10 presents the summary data for the detected contaminants in surface water of Little Sulphur Creek. Relatively low concentrations of all analytes were detected. Three explosives were found (2,4-DNT, HMX, RDX), along with several SVOCs and metals. Only the metals displayed a high frequency of detection.

Table 4-11 provides the summary data for the sediment contaminants detected in Little Sulphur Creek. Contaminants at the highest concentrations are metals (Al, Ba, Cu, Pb and Zn). Low levels of explosives, SVOCs and VOCs were also detected. The metals also had the highest frequency of detection (most at 100 percent), followed by certain explosives (2,4,6-TNT at 83 percent; HMX at 67 percent), di-n-butylphthalate (at 100 percent), and acetone (at 75 percent).

Table 4-12A summarizes the detected contaminants in on-site springs at ABG (springs A, B, and C). HMX and RDX were detected in all three of the springs, as were aluminum, arsenic, and barium. Detected with less frequency (1 out of 3 springs) were 1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, and trichloroethylene). Table 4-12B shows that the off-facility springs (8 and 10) had fewer contaminants which were present in lower concentrations. No explosives were detected in off-facility springs 8 and 10. Table 4-12C summarizes the detected contaminants in on-site Spring A.

Groundwater

Table 4-13 displays the summary data for the detected analytes in the Beaver Bend aquifer beneath the ABG. Only two metals (As, Zn) and four SVOCs [benzo(a)anthracene, chrysene, bis(2-ethylhexyl)phthalate, N-nitrosodiphenylamine] were detected. All analytes were found at very low concentrations (<0.01 mg/L)

Table 4-14 presents the summary data for the identified contaminants in the Beech Creek/Big Clifty aquifer beneath the ABG. This aquifer contains the greatest number of contaminants, including representatives from all five analytical groups:

- Explosives (1,3,5-trinitrobenzene, 2-amino-4,6-dinitrotoluene, HMX, nitrobenzene, RDX).
- Inorganics (Al, As, Ba, Cr, CN, Pb, Mn, Hg, Zn).
- VOCs (2-butanone, acetone, methylene chloride).
- SVOCs [1,2-dichloroethane, 1,2-dichloroethylene, benzyl alcohol, bis(2-ethylhexyl) phthalate, c-1,2-dichloroethylene, N-nitrosodiphenylamine, tetrachloroethylene, t-1,2-dichloroethylene, trichloroethylene, vinyl chloride].
- Pesticides (aldrin, heptachlor epoxide).

Contaminants at the highest frequencies include manganese (94 percent), zinc (81 percent), trichloroethylene (69 percent), and four analytes around 50 percent (RDX, HMX, lead, methylene chloride).

Presented in Table 4-15 are the summary data for the detected contaminants in the Golconda aquifer beneath the ABG. A variety of metals were found to be present, along with two explosives (HMX, RDX). No VOCs or SVOCs were detected in this aquifer.

Presented in Table 4-16 are the summary data for the contaminants detected in the alluvial aquifer at the juncture of Little Sulphur Creek and Johnson Hollow (i.e. at the Facility boundary). A variety of metals were detected, along with a variety of SVOCs/VOCs. The organic contaminants at the highest concentrations were trichloroethylene (2.3 mg/L), 1,2-dichloroethylene (1.15 mg/L), and 1,1,2,2-tetrachloroethane (0.5 mg/L). Aluminum and manganese were the two metals detected at the highest concentrations.

Presented in Table 4-17 are summary data for Beech Creek wells at the Jeep Trail Area. Contamination in these wells includes explosives (2,4,6-trinitrotoluene, 2,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, HMX, RDX), metals and SVOCs. Chemicals detected at the highest concentrations (> 1 mg/L) were the metals. Metals were also the contaminants with the highest frequency of detection, although HMX and RDX were both detected in four of the six wells sampled.

In Table 4-18 are presented the summary data for ABG well 03C28, which is currently operational at this SWMU as a water source for employees. Contaminants detected in this well include primarily metals, with several VOCs/SVOCs [acetone, methylene chloride, benzyl alcohol, bis(2-ethylhexyl)phthalate]. With the exceptions of aluminum and barium, all concentrations are at low levels (< 0.1 mg/L).

4.4.2.2 ORR

Soil

Table 4-19 provides a summary of the detected contaminants in surface soil at the ORR. The contaminants detected at the highest concentrations are metals (Al, Ba, Pb, Mn and Zn). Lesser amounts of polynuclear aromatic hydrocarbons (PAHs) [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene] and explosives (2,4-DNT; 2,4,6-TNT) were also found. The explosives, however, unlike the metals, were found at low frequencies (3 to 11 percent).

Table 4-20 provides the summary data for the combination of surface and subsurface soils at the ORR. Metals (Al, Ba, Mn, Pb, and Zn) again are at the highest concentrations, followed by much lower levels of explosives (2,4-DNT; 2,4,6-TNT) and PAHs.

Surface Water/Sediment

Presented in Table 4-21 are the summary data for Turkey Creek surface water. Low levels of five metals (Al, Co, Cu, V, and Zn) and one SVOC (butylbenzylphthalate) were found.

Turkey Creek sediment, however, contained a much greater number of contaminants (Table 4-22). Contaminants at the highest concentrations include four metals (Al, Ba, Mn, and Zn). Only one explosive was found (2,4-DNT), along with very low levels (<0.1 mg/kg) of two VOCs (2-butanone, acetone) and several SVOCs [benzo(b)fluoranthene, chrysene, di-n-butylphthalate, fluoranthene, N-nitrosodiphenylamine, pyrene].

Groundwater

Presented in Table 4-23 are the summary data for the Beech Creek wells at the ORR. All contaminants identified in these wells were at low levels (< 0.1 mg/L). Contaminants included explosives (2,4,6-trinitrotoluene, HMX, RDX), VOCs, SVOCs, metals and one pesticide (heptachlor epoxide). Manganese (100 percent) and zinc (75 percent) were the only compounds detected at a high frequency.

Presented in Table 4-24 is a summary of the contaminant concentrations in the Alluvial aquifer beneath the ORR. Contamination in this aquifer includes explosives (2,4,6-trinitrotoluene, 2,6-dinitrotoluene, RDX), metals and SVOCs. Only 2,4,6-trinitrotoluene (0.12 mg/L), aluminum (0.5 mg/L), barium (0.12 mg/L) and manganese (0.58 mg/L) were detected at concentrations greater than 0.1 mg/L. Contaminants at the highest frequency include manganese (100 percent), aluminum (57 percent), and barium (57 percent).

4.4.2.3 DR

Soil

Presented in Table 4-25 are the summary data for surface soil contaminants at the Navy Detonation Area. Contaminants detected at the highest concentrations include several metals (Ba, Cu, Zn). Low levels (<1 mg/kg) of explosives (2,4-DNT; 2,4,6-TNT; RDX) and SVOCs [benzo(g,h,i)perylene, butylbenzylphthalate, chrysene, di-n-butylphthalate, fluoranthene, hexachlorobenzene, phenanthrene, pyrene] were also detected.

The summary surface soil data for the Army Detonation Area at DR are presented in Table 4-26. Contaminants detected at the highest concentrations in this area are two metals (Cu, Zn). Lesser concentrations of other metals (Pb, Ni, V), cyanide, and explosives (RDX) were also found. Phthalate esters were found at low levels (<1 mg/kg), as were several PAHs.

Surface Water/Sediment

Table 4-27 presents a summary of the chemical contaminants found in surface water in Boggs Creek. Low levels of nine metals were found, along with one detection of trichloroethylene.

Boggs Creek sediment (Table 4-28) was determined to be contaminated with low levels of five chemicals, three VOCs (2-butanone, acetone, toluene) and two SVOCs (butylbenzylphthalate, di-n-butylphthalate).

Groundwater

Presented in Table 4-29 are summary data for the identified contaminants in the Beech Creek aquifer beneath the DR. Contamination includes metals, one VOC (acetone) and three SVOCs (1,4-dichlorobenzene,

butylbenzylphthalate, diethylphthalate). Barium (86 percent) and manganese (71 percent) were found at the highest frequency, and only barium was detected at a concentration greater than 0.10 mg/L.

Presented in Tables 4-30A and B are summaries of the contaminant concentrations in the Alluvial aquifer beneath the DR-Navy detonation area and DR-Army detonation area, respectively. Contaminants beneath the Navy detonation area include metals, one explosive (RDX) and one SVOC (naphthalene). Aluminum was detected at the highest concentration (81.8 mg/L), followed by manganese (6.64 mg/L), zinc (1.82 mg/L) and nickel (1.06 mg/L). Contaminants beneath the Army detonation area include metals, and three SVOCs [2,4,6-trichlorophenol, bis(2-ethylhexyl)phthalate, butylbenzylphthalate]. Only aluminum was detected at a concentration above 1.0 mg/L.

4.4.2.4 Wildlife Database

Presented in Table 4-31 are the summary data for contaminants detected in venison from the facility. Contaminants include several metals, several SVOCs and two VOCs (2-butanone, acetone). Zinc, a nutrient metal, was present at the highest concentrations, followed by aluminum and copper.

4.5 DATA EVALUATION

This section of the risk assessment evaluates the final aforementioned analytical datasets for their useability in this risk assessment of the three SWMUs at NAVSURFWARCENDIV. Useability of the data for a risk assessment is assessed by determining the data's level of certainty/uncertainty. Three basic questions are asked and answered in this analysis:

- Have the chemical constituents present in site media been adequately characterized and accurate levels established?
- Have all of the exposure pathways and areas of potential concern in the Site Conceptual Model been identified and sufficiently addressed?
- Are the primary exposure media at the site sufficiently characterized?

The recommendations in the USEPA's manual entitled "Guidance for Data Useability in Risk Assessment" (USEPA, 1992C) was followed in performing this evaluation. Six criteria, as described in this manual, were used to judge the adequacy of the data for this assessment:

- Quality of data reports.
- Completeness of documentation.
- Completeness and relevance of data sources.
- Adequacy of analytical methods and detection limits.
- quality and completeness of data validation.
- Comparison of data quality indicators.

This data useability analysis addresses both historical results (i.e. those results approved for use in this risk assessment by USEPA) and results for samples collected by the HNUS team in 1997. Assessing the level of certainty/uncertainty focuses on the analytical data which is incorporated for use in the risk assessment.

4.5.1 Quality of Data Reports

The RAWP (HNUS, 1995) of this site provides a detailed description of the area and the historical data that are used in this risk assessment. The information provided in the RAWP sections include a description of the site, its historical operations, detailed maps showing the regional setting and the overall layout of the site.

The work plan sections included a summary of the past investigation scope, the rationale for selection of sampling locations, and a description of the analytical methods used.

This analytical data set, however, had never received independent data validation. For the purposes of this assessment, approximately ten percent of the historical site data were reviewed by USEPA Region 5 to determine which data from each of the five laboratories that had been used at this Facility were acceptable for use in this study. Region 5 provided recommendations for data use in correspondence dated June 24, 1997. Historical data recommended for project use were:

- 1995-6 HNUS team data for VOCs, SVOCs, PCB/pesticides, metals, and explosives.
- Enseco data for VOCs, SVOCs, PCB/pesticides, metals and explosives.
- WES data for explosives.

In view of the fact that much of the historical data were now lost to this study, the HNUS team re-evaluated the remaining data and made recommendations regarding necessary supplemental data (HNUS, 1997). Data obtained in 1997 are used to fill in data gaps identified by the HNUS team in "The Environmental Data Assessment Memorandum" dated July 1997. The protocols for this 1997 supplemental sampling and analysis phase are provided in Appendix D of this document. These protocols were identical to those used in the HNUS 1995 supplemental data gathering phase.

All Enseco results and the 1995 and 1997 HNUS team analyses were conducted according to USEPA methods. For the 1995 and 1997 data, Level IV quality data was accomplished for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), PCB/pesticides, and metals and cyanide through following Contract Laboratory Program (CLP) methodology. Level III quality data was accomplished for all other analyses.

WES analyses were performed in accordance with laboratory standard operating procedures (SOPs). The following comments were provided by USEPA regarding their reports:

> "Although data documentation was poor, communication with the lab analyst who was involved with the analytical work permitted reconstruction of the case. Validation of WES' data packages would not be possible because significant information pertaining to calibrations is not acceptably presented. SOPs originally used in 1990 and 1993 were not provided. Nevertheless, it was the reviewer's impression that the data was reliably generated and that the WES package supplemented with the lab analyst's recollections (subjectively) qualifies the data for risk assessment purposes."

One hundred percent of the HNUS Team 1995-6 and 1997 data sets were independently validated. Independent validation also occurred for approximately 40 percent of the Enseco data for VOCs, SVOCs and metals analyzed. These results, including data qualified either "J" or "U", are suitable for the purposes of the risk assessment. No validation was conducted by the HNUS team for the Enseco explosives data or PCB/pesticide data or the WES explosives data.

4.5.2 Completeness of Documentation

Data collection and analysis procedures must be accurately documented in order to substantiate the analyses of each sample, the proper correlation of sample results to geographic locations, the conclusions drawn from those analyses, and the reliability of the reported analytical data. Assessment of the site documentation, therefore, involves an examination of:

- Chain-of-custody records.
- Records of sampling location and sampling dates.

- Analytical records.

All HNUS Team 1995-6 and 1997 documentation was found to be complete during the review conducted by the independent data validator. Data omissions were noted in the validation reports for the Enseco data; however, the validator indicated no action was necessary due to the omissions.

4.5.3 Completeness and Relevance of Data Sources

All data sources for the HNUS team's 1995 and 1997 phases of work were complete. Enseco's historical data packages were nearly complete. No review for completeness was conducted on the historical WES data packages.

4.5.4 Adequacy of Analytical Methods and Detection Limits

Appropriate analytical methods are those that have detection limits that meet risk assessment requirements for COPCs and have sufficient QC measures to quantitate chemical identification and measurement. Appropriate analytical methods minimize the probability of false negative results, i.e. non-detection of an analyte when it truly is present at potentially significant concentrations (i.e., concentrations above health-based levels). In this section of the risk assessment, a summary is provided of the comparisons made between risk-based values (USEPA Region 5 Data Quality Level) and the sample-specific detection limits (DLs) for all chemicals that were analyzed for but not detected in soil, sediment, surface water and groundwater at this site. These comparisons have been made for each sample matrix. There are no DQLs specific to surface water, springs or sediment. DQLs for ground water and soil were used for these matrices.

The USEPA Region 5 Data Quality Levels were presented in a memorandum dated December 1995, and were developed to provide human health-based target levels for RCRA investigative and remedial activities. These DQLs were based solely on the USEPA Region 9 Preliminary Remediation Goals (PRGs). In addition to the DQLs, the 1995 memorandum provided a list of typical analytical methods along with the corresponding Method Reporting Limits (MRLs). If a DQL has not been established, and an MRL is listed, the project DL was compared to the MRL. No comparisons were made for analytes not included on the Region 5 DQL table.

Ground Water, Surface Water, and Springs

Maximum detection limits (DLs) in water samples that were obtained compared to the DQLs and the EPA Method Reporting Limits are shown on Table 4-32. A comparison was conducted for each of the four data sets used for the risk assessment. Also, separate comparisons were performed for the ground water and the surface water/spring matrices. The purpose of the comparison was two-fold. First, to identify site areas where elevated detection limits were observed and second, to determine if the analytical methods used had sufficient sensitivity to meet the DQLs.

No site areas with elevated detection limits were observed. Limited ground water samples had elevated detection limits due to sample dilution. These were:

Sample No.	Data Set	Analyte Group	Dilution Factor
03C20	Enseco	VOCs	25x
03C11	Enseco	VOCs	10x
03C04	Enseco	SVOCs	2x
CR95-03GW-03-07-01DL	REI 1995	VOCs	20x

Other ground water samples in these data sets had maximum detection limits equivalent to the surface water samples for the same data sets.

Analytes which had a DL greater than a DQL (or MRL, when appropriate) were divided into three categories:

1. Sample results which had a DL greater than the DQL and the EPA MRL was lower than the DQL.

2. Sample results which had a DL greater than the DQL and the EPA MRL was higher than the DQL.

3. Sample results compared only to the EPA MRL due to the absence of a DQL.

Samples associated with the first category above, have the potential for achieving a lower DL using an alternative analytical method. The number of compounds exceeding the EPA DQLs, for each data set in this category, were:

Data Set	Matrix	Number of Compounds
Enseco	Ground Water	32
WES	Ground Water, Surface Water, and Springs	2
REI 1995	Ground Water, Surface Water, and Springs	20
REI 1997	Ground Water, Surface Water, and Springs	9 - 10

The low number for the WES data set is due to the fact that only explosives were analyzed. The high number for the Enseco ground water data set appeared to be due to dilutions for two VOC scans (03C20 at a 25x dilution and 03C11 and a 10x dilution) and one SVOC scan (03C04 at a 2x dilution). For the remainder of the Enseco ground water data set, the DLs were those achieved for the surface water matrix. Since the analytical methods used were broad spectrum analyses which included several compounds, rather than targeting specific analytes, the DLs achieved for the project were determined to be acceptable for the human health risk assessment.

Sample results associated with the second category above do not necessarily have analytical methods which could achieve the EPA DQL. Sample DLs were compared to the EPA MRLs to determine if these were met. Data with atypical detection limits were removed from this comparison and included the samples analyzed at dilutions listed above. The EPA MRLs were achieved for 21 out of the 50 analytes included in this category. For these analytes, methods may or may not exist which could provide a DL at or below the DQL. For the remaining 29 analytes, alternative methods do exist which could provide lower detection limits. However, since the analytical methods used were broad spectrum analyses, the DLs achieved for the project were determined to be acceptable for the human health risk assessment.

For the third category above, EPA DQLs have not been established because health risk information is unavailable. Sample DLs were compared to the EPA MRL. No further evaluation was conducted since the MRLs are values based on analytical technology rather than health-based information.

Soil and Sediment

Maximum detection limits for all of the non-detected analytes in soils and sediments at the three SWMUs were compared to the DQLs and the EPA Method Reporting Limits. These comparisons are presented in Table 4-33 for the various sites. A separate comparison was conducted for each of the areas where soil or sediment samples were collected. Samples were analyzed for VOCs, SVOCs, PCB/pesticides, and metals. The DLs achieved were acceptable when compared to the risk-based criteria, with the exception of the following seven chemicals:

Vinyl chloride
Benzo(a)pyrene
bis(2-chloroethyl)ether
Dibenzo(a,h)anthracene

Hexachlorobenzene
N-nitroso-di-n-propylamine
PCB-1221

One sample in the Jeep Trail Area had DLs which exceeded the DQLs for a total of 16 parameters. However, this sample was a duplicate. The original sample, along with all other samples in this area, had DLs less than the DQLs for all, but the above compounds. For two of the above analytes, lower DLs may not be possible from an analytical standpoint. The USEPA Region 5 Method Reporting Limits for bis(2-chloroethyl)ether and N-nitroso-di-n-propylamine were also above the DQLs. The fact that DLs exceeded the Region 5 DQLs contributes to the uncertainty in the risk assessment. However, overall, the DLs achieved for the project were determined to be acceptable for the human health risk assessment.

In the absence of DQLs, DLs were compared to the Region 5 Method Reporting Limits. Analytes above these limits were:

2-Methylnaphthalene
2-Nitrophenol
4-Bromophenylphenylether
4-Chloro-3-methylphenol
4-Chlorophenylphenylether
4-Nitrophenol
Acenapthylene
Benzo(g,h,i)perylene
bis(2-chloroethyoxy)methane

Again, several additional compounds exceeded the Method Reporting Limit for the single Jeep Trail duplicate sample. DLs for the original sample were below the Method Reporting Limit for those compounds and the elevated DLs in the duplicate sample will not affect the risk assessment.

4.5.5 Quality of Data

One hundred percent of the HNUS Team 1995-6 and 1997 samples were independently validated using the "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review" (February 1994), "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review" (February 1994), Region V "Standard Operating Procedure for Validation of CLP Inorganic Date (September 1993) and "Standard Operating Procedure for Validation of CLP Organic Data" (April 1991, revised August 25, 1993). Additionally, approximately 40 percent of the Enseco data for VOCs, SVOCs, and metals was validated by A.T. Kearney using "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review" (February 1994), "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review" (February 1994). No validation was performed for the Enseco explosive or PCB/pesticide data or the WES explosive data.

Qualifiers were used during the validation process to indicate that the data are: 1) usable as a quantitative concentration; 2) usable with caution as an estimated concentration (coded J); or 3) unusable due to out-of-control QC results (coded R).

The purpose of the validation was to raise any significant issues regarding the probability of false positive or false negative results and quantitation errors in the project database. Validation was conducted through a systematic review of the data for compliance to established QC criteria (based on the QC results provided by the laboratory). It included an evaluation of the direction of bias, based on the results of QC samples. As part of the validation the following components were examined:

- Verification of instrument calibration.
- Examination of blanks for contamination.
- Assessment of adherence to method specifications and QC limits.
- Evaluation of method performance in the sample matrix.

The validated data reports documented the following information:

- Results for each analyte and each sample, qualified for analytical limitations.
- Sample-specific detection limits {DLs} (as reported by the analytical laboratory including the DLs for undetected analytes, with an explanation of any qualifications).

4.5.6 Comparison of Data Quality Indicators

During preparation of the risk assessment, data quality indicators are assessed to determine whether individual results for each samples, as well as entire data sets for each area at a SWMU, are of known and acceptable quality. This assessment requires an evaluation of the data with regard to the following five criteria:

- *Completeness* - Are there sufficient data of known and acceptable quality for each medium, exposure pathway and COPC to characterize risk? If not, what effect does this deficiency have on the risk assessment?

- *Comparability* - Were all data analyzed using comparable methods? Are samples reported in consistent units with consistent reporting limits?

- *Representativeness* - Are the data representative of the contamination in each medium (both in terms of concentration and location)? Did the sampling or analysis procedures affect the representativeness (e.g., poor matrix recovery or inappropriate composting)?

- *Precision* - Were sufficient data collected to estimate laboratory and field variability? What is the impact of the field variability on the original RI Work Plan sampling scheme's ability to detect "hot spots" and to establish background concentrations?

- *Accuracy* - Were sample spikes (matrix spikes), QC spikes and surrogates analyzed to assess accuracy of nondetected and detected sample results?

Analytes were eliminated from this risk assessment if they were not detected in any of the samples in a particular medium, when their data are coded 'R' (unusable), and/or if their concentrations are considered artifactual, i.e. due to laboratory/field contamination. In accordance with USEPA guidance (1989a), when the detected concentration in a sample was less than ten times the blank concentration for common laboratory contaminants (e.g. acetone, methylene chloride, and the phthalate esters), it was interpreted that the detection represents artificially introduced contamination. In such cases, the chemical was not considered further in the risk assessment. For those organic or inorganic chemicals that are not designated common laboratory contaminants by the USEPA (all other compounds), the chemical was not selected for evaluation in the risk assessment when the detected concentration was less than five times its maximum detected concentration in the blanks (USEPA, 1989a).

Completeness

The sample set evaluated for completeness includes background samples and samples used in the human health risk assessment. Analytical completeness is defined as the number of acceptable (useable) samples divided by the total number of samples analyzed.

Data needs, in addition to the data approved for project use, were identified in "The Environmental Data Assessment Memorandum" dated July 1997. Sampling to fill these gaps was conducted in August 1997. Results for this sampling event were calculated to be 97.8 percent complete (Rust, 1997). The following list summarizes unusable data for the 1997 event:

- Acetone, 2-butanone, and 1,2-dibromo-3-chloropropane results for ten ground water samples, two surface water samples and one sediment sample.
- Selenium results for four sediment and 29 surface soil samples.
- Total selenium results for ten ground water samples and two surface water samples.
- Dissolved selenium results for seven ground water samples.
- Total antimony results for three ground water and two surface water samples.
- Total arsenic results for one ground water sample.

The 1997 sampling event, combined with the historical data, was designed to bring the data set for the risk assessment to 100 percent complete. The missing results could introduce some uncertainty, albeit small, into the risk assessment.

Comparability

Data comparability is determined to be acceptable. USEPA Region 5 reviewed approximately ten percent of the historical data and selected the data sets with sufficient documentation and adequate associated quality control results for use in the risk assessment. The 1997 data were produced using USEPA CLP methodology, when available, and USEPA approved methodology for all other analyses. Data were reported with different units, however, this has been taken into account in the data assembly section in this risk assessment.

Representativeness

Representativeness of the data is also considered to be acceptable for risk assessment purposes. In general, data collected during the RI are viewed as sufficient and representative of site conditions. Although media sampling was "targeted" (e.g. non-random), sampling procedures do not appear to have significantly impacted data representativeness. Sampling locations, methods and quantity of samples needed to characterize contaminant extent were carefully planned in advance of field work after a through review of site history and historical data. For all media sampled, the list of analytes (VOCs, SVOCs, metals and explosives) was comprehensive.

The analytical data are also interpreted as being adequate to characterize current site conditions in terms of the magnitude of chemical concentrations. Background samples for soil and ground water were appropriately located to be representative of non-site related chemical concentrations.

Precision and Accuracy

Analytical accuracy and precision were evaluated during the data validation process. Data qualified with a J code may indicate minor accuracy or precision problems. Data qualified as unusable (with an R code) were removed from the database. All validated data used in the risk assessment were found to have acceptable levels of precision and accuracy. The precision and accuracy levels were not reviewed for non-validated data, as mentioned earlier, and introduces some uncertainty to the risk assessment.

4.5.7 Conclusions

In summary, the data sets comprising the data presented in Tables 4-7 through 4-31 were reviewed for useability and are determined to be adequate for risk assessment purposes. In general, chemical contamination which may be present in site media appears to be properly characterized. The level of accuracy regarding the concentrations of detected chemicals is acceptable. All of the exposure pathways and areas of concern identified in the risk assessment work plan's preliminary site conceptual model have been sufficiently addressed in the sampling and analysis program.

TABLE 4-1

SWMU - EXPOSURE PATHWAY ANALYSIS
CURRENT LAND USE SCENARIO
Page 1 of 2

Contaminant Sources	Potentially-exposed Population	Exposure Route	Likelihood of Pathway Completion	Selection for Quantitative Evaluation	Reason for Selection or Exclusion
Ammunition Burning Ground • Surface soil • Surface water/ Sediment (Little Sulfur Creek) • Springs • Groundwater	Base personnel/ families	Inhalation of vapor-phase chemicals	High	No	Air emissions are evaluated in a separate, companion risk assessment.
		Inhalation of contaminated airborne particulates	High	No	
		Ingestion of contaminated airborne particulates	High	No	
		Ingestion of contaminated soil near Lake Greenwood	High	No	Evaluation of direct contact with soil contaminated near Lake Greenwood due to particulate deposition is evaluated in companion risk assessment.
		Dermal contact with contaminated soil near Lake Greenwood	High	No	
Old Rifle Range • Surface soil • Surface water/ Sediment (Turkey Creek) • Groundwater		Ingestion of contaminated surface soil at SWMUs	High	Yes	Adult personnel assumed to 'visit' each SWMU as part of their job.
		Dermal contact with contaminated surface soil at SWMUs	High	Yes	
		Ingestion of contaminated subsurface soil at SWMUs	Low	No	Not likely Base Personnel would dig into soil at these SWMUs.
		Dermal contact with contaminated subsurface soil at SWMUs	Low	No	
Demolition Range • Surface soil • Surface water/ Sediment (Boggs Creek) • Groundwater		Ingestion of contaminated drinking water (Lake Greenwood)	High	No	Lake Greenwood serves as source of base water for drinking and showering/bathing. Particulate deposition would also occur over lake, so this pathway is evaluated in the companion risk assessment. Groundwater flow at SWMUs away from Lake Greenwood.
		Dermal contact with contaminated water (Lake Greenwood)	High	No	Airborne VOC impact on Lake Greenwood expected to be negligible.
		Inhalation of vapor-phase chemicals while showering	Low	No	Some potential for these receptors to play in Facility creeks.
		Incidental ingestion of contaminated water in Facility creeks	Medium	Yes	
		Dermal contact with contaminated water in Facility creeks	Medium	Yes	
		Incidental ingestion of contaminated sediment in Facility creeks	Medium	Yes	
		Ingestion of contaminated beef/milk	Low	No	
		Ingestion of contaminated vegetables	Low	No	
		Ingestion of venison/turkey	Medium	No	
			Low	No	

TABLE 4-1 (Continued)
SWMU - EXPOSURE PATHWAY ANALYSIS
CURRENT LAND USE SCENARIO
Page 2 of 2

Contaminant Sources	Potentially-exposed Population	Exposure Route	Likelihood of Pathway Completion	Selection for Quantitative Evaluation	Reason for Selection or Exclusion
Ammunition Burning Ground	Base personnel/ families	Dermal contact with contaminated sediment in Facility creeks	Medium	Yes	
• Surface soil		Ingestion of contaminated fish from Facility creeks	Low	No	Fishing by these receptors in Facility creeks may occur; however, creeks are not a viable recreational resource.
• Surface water/ Sediment (Little Sulfur Creek)		Ingestion of spring water	Low	No	
• Springs		Dermal contact with spring water	Low	No	No livestock are raised on base.
• Groundwater		Ingestion of contaminated beef/milk	Low	No	Very few garden crops are raised on base by personnel stationed at NAVSURFWARCENDIV.
Old Rifle Range		Ingestion of contaminated vegetables	Medium	No	Hunting by these receptors occurs infrequently.
• Surface soil		Ingestion of venison/turkey	Low	No	High potential for these receptors to recreate in this Lake, which is near where they live. This exposure pathway is evaluated in the companion document.
• Surface water/ Sediment (Turkey Creek)		Incidental ingestion of contaminated water in Lake Greenwood	High	No	
• Groundwater		Dermal contact with contaminated water in Lake Greenwood	High	No	Potential for these receptors to recreate in this Lake, which is near to where they live. This exposure pathway is evaluated in the companion risk assessment. Groundwater flow at SWMUs away from Lake Greenwood.
Demolition Range					
• Surface soil		Ingestion of contaminated groundwater at SWMUs	Low	No	
• Surface water/ Sediment (Boggs Creek)		Dermal contact with contaminated groundwater at SWMUs	Low	No	
• Groundwater					

TABLE 4-2

SWMU - EXPOSURE PATHWAY ANALYSIS
CURRENT LAND USE SCENARIO
Page 1 of 2

Contaminant Source	Potentially-exposed Population	Exposure Route	Likelihood of Pathway Completion	Selection for Quantitative Evaluation	Reason for Selection or Exclusion
Ammunition Burning Ground	Off-facility rural residents	Inhalation of vapor-phase chemicals	High	No	Potential for air emissions from ordnance burning and detonation to impact ambient air off of NAVSURFWARCENDIV is high. This pathway is evaluated in companion risk assessment.
• Surface soil		Inhalation of contaminated airborne particulates	High	No	
• Surface water/ Sediment (Little Sulfur Creek)		Ingestion of contaminated airborne particulates	High	No	
• Springs		Ingestion of contaminated off-facility soil	High	No	Potential for non-volatile air emissions to disperse in air, and deposit and accumulate in off-facility soil. This pathway, therefore, is evaluated in companion risk assessment.
• Groundwater					
Old Rifle Range		Dermal contact with contaminated off-Facility soil	High	No	
• Surface soil		Ingestion of contaminated surface/subsurface soil at SWMUs	Low	No	These receptors do not have access to these SWMUs.
• Surface water/ Sediment (Turkey Creek)					
• Groundwater		Dermal contact with contaminated surface/subsurface soil at SWMUs	Low	No	
Demolition Range					
• Surface soil		Ingestion of contaminated ground water	High	Yes	Potential for exposure to groundwater contaminated by off-facility transport of solutes.
• Surface water/ Sediment (Boggs Creek)		Dermal contact with contaminated ground water	High	Yes	
• Groundwater		Inhalation of vapor-phase chemicals while showering	High	Yes	Volatile contaminants present in groundwater.
		Incidental ingestion of contaminated water in Facility creeks	Medium	Yes	Some potential for these receptors to contact Facility creeks.
		Dermal contact with contaminated water in Facility creeks	Medium	Yes	
		Incidental ingestion of contaminated sediment in Facility creeks	Medium	Yes	
		Dermal contact with contaminated sediment in Facility creeks	Medium	Yes	
		Ingestion of contaminated fish from Facility creeks	Low	No	Fishing by these receptors in Facility creeks may occur; however, creeks are not a viable recreational source.
		Ingestion of contaminated beef/milk	High	No	Potential for chemicals in air emission to accumulate in livestock, and crops off the facility. These exposure pathways are evaluated in companion risk assessment.

TABLE 4-2 (Continued)
SWMU - EXPOSURE PATHWAY ANALYSIS
CURRENT LAND USE SCENARIO
Page 2 of 2

Contaminant Source	Potentially-exposed Population	Exposure Route	Likelihood of Pathway Completion	Selection for Quantitative Evaluation	Reason for Selection or Exclusion
Ammunition Burning Ground	Off-facility rural residents	Ingestion of contaminated vegetables	High	No	Potential for chemicals is air emissions to accumulate in off-Facility vegetables. This exposure pathway is evaluated in companion document.
• Surface soil		Ingestion of venison/turkey	Medium	Yes	Hunting by local residents is allowed on the Base.
• Surface water/ Sediment (Little Sulfur Creek)		Ingestion of spring water	High	Yes	Off-facility residents reported to drink/bathe in spring water near ABG.
• Springs		Dermal contact with spring water while bathing	High	Yes	
• Groundwater					
Old Rifle Range					
• Surface soil					
• Surface water/ Sediment (Turkey Creek)					
• Groundwater					
Demolition Range					
• Surface soil					
• Surface water/ Sediment (Boggs Creek)					
• Groundwater					

TABLE 4-3

SWMU - EXPOSURE PATHWAY ANALYSIS
CURRENT LAND USE SCENARIO

Contaminant Source	Potentially-exposed Population	Exposure Route	Likelihood of Pathway Completion	Selection for Quantitative Evaluation	Reason for Selection or Exclusion
Ammunition Burning Ground • Surface soil • Surface water/ Sediment (Little Sulfur Creek) • Springs • Groundwater	SWMU workers	Inhalation of vapor-phase chemicals	High	No	Potential for direct exposure to air emissions from ordnance burning and detonation is high. This exposure pathway is evaluated in companion risk assessment.
		Inhalation of contaminated airborne particulates	High	No	
		Ingestion of contaminated airborne particulates	High	No	
		Ingestion of contaminated on-SWMU soil	High	Yes	High potential for direct contact with contaminated soil by SWMU workers.
Old Rifle Range • Surface soil • Surface water/ Sediment (Turkey Creek) • Groundwater		Dermal contact with contaminated on-SWMU soil	High	Yes	
		Ingestion of contaminated ground water	Medium	Yes	Potential for SWMU workers at ABG to contact contaminants in groundwater at this SWMU.
		Dermal contact with contaminated groundwater	Medium	Yes	
Demolition Range • Surface soil • Surface water/ Sediment (Boggs Creek) • Groundwater		Inhalation of vapor-phase chemicals while showering	Low	No	No showing/bathing facilities at ABG.
		Incidental ingestion of contaminated water in Facility creeks/ springs	Low	No	SWMU workers unlikely to have significant or frequent contact with Facility creeks or creeks.
		Dermal contact with contaminated water in Facility creeks/ springs	Low	No	
		Incidental ingestion of contaminated sediment in Facility creeks	Low	No	
		Dermal contact with contaminated sediment in Facility creeks	Low	No	
		Ingestion of contaminated fish from Facility creeks	Low	No	Fishing by these receptors in Facility creeks may occur; however, creeks are not a viable recreational source.
		Ingestion of contaminated beef/milk	Low	No	Low potential for SWMU workers to receive high percentage of their dietary foodstuffs from local sources.
		Ingestion of contaminated vegetables	Low	No	
		Ingestion of venison/turkey	Medium	Yes	Hunting by these receptors does occur; however, venison/turkey is not a major part of their diet.

TABLE 4-4

**SWMU - EXPOSURE PATHWAY ANALYSIS
FUTURE LAND USE SCENARIO**

Contaminant Source	Potentially-exposed Population	Exposure Route	Likelihood of Pathway Completion	Selection for Quantitative Evaluation	Reason for Selection or Exclusion
Ammunition Burning Ground • Surface soil • Surface water/ Sediment (Little Sulfur Creek) • Springs • Groundwater Old Rifle Range • Surface soil • Surface water/ Sediment (Turkey Creek) • Groundwater Demolition Range • Surface soil • Surface water/ Sediment (Boggs Creek) • Groundwater	Park visitors/ employees	Inhalation of vapor-phase chemicals	Low	No	Under this scenario, burning/detonation activities have ceased and the SWMUs are turned into a park. Low potential for volatile emissions.
		Inhalation of contaminated airborne particulates	Low	No	Low potential for exposure to air emissions due to fugitive dust.
		Ingestion of contaminated airborne particulates	Low	No	
		Ingestion of contaminated on-SWMU soil	High	Yes	High potential for direct contact with contaminated soil.
		Dermal contact with contaminated on-SWMU soil	High	Yes	
		Ingestion of contaminated groundwater	Medium	Yes	Drinking water wells could be installed throughout the Park area, including at these SWMUs.
		Dermal contact with contaminated ground water	Medium	Yes	
		Inhalation of vapor-phase chemicals while showering	Low	No	Showers not likely to be installed at park.
		Incidental ingestion of contaminated water in creeks/springs	High	Yes	Potential for park visitors to play in Facility creeks and associated on-facility springs is high.
		Dermal contact with contaminated water in creeks/springs	High	Yes	
		Incidental ingestion of contaminated sediment in Facility creeks	High	Yes	
		Dermal contact with contaminated sediment in Facility creeks	High	Yes	
		Ingestion of contaminated fish from Facility creeks	Low	No	Fishing by these receptors in Facility creeks may occur; however, creeks are not a viable recreational source.
		Ingestion of contaminated beef/milk	Low	No	Route of exposure not expected to be applicable to this receptor.
		Ingestion of contaminated vegetables	Low	No	Route of exposure not expected to be applicable to this receptor.
		Ingestion of venison/turkey	Medium	Yes	Deer and turkey hunting does occur at base, albeit infrequently. Hunting activity could increase substantially if land converted to park/natural area.

TABLE 4-5

SWMU - EXPOSURE PATHWAY ANALYSIS
FUTURE LAND USE SCENARIO

Contaminant Source	Potentially-exposed Population	Exposure Route	Likelihood of Pathway Completion	Selection for Quantitative Evaluation	Reason for Selection or Exclusion
Ammunition Burning Ground	On-SWMU residents	Inhalation of vapor-phase chemicals	Low	No	Under this scenario, burning/detonation activities have ceased and the SWMUs are turned into residential areas.
• Surface soil		Inhalation of contaminated airborne particulates	Low	No	Low potential for exposure to SWMU air emissions due to fugitive dusts.
• Surface water/ Sediment (Little Sulfur Creek)		Ingestion of contaminated airborne particulates	Low	No	
• Springs		Ingestion of contaminated on-SWMU soil	High	Yes	High potential for direct contact with contaminated soil.
• Groundwater		Dermal contact with contaminated on-SWMU soil	High	Yes	
Old Rifle Range		Ingestion of contaminated ground water	High	Yes	On-site residents likely to have drinking water well.
• Surface soil		Dermal contact with contaminated ground water	High	Yes	
• Surface water/ Sediment (Turkey Creek)		Inhalation of vapor-phase chemicals while showering	High	Yes	VOCs are present in groundwater.
• Groundwater		Incidental ingestion of contaminated water in Facility creeks/springs	High	Yes	Potential for residents to play in Facility creeks and springs is high.
Demolition Range		Dermal contact with contaminated water in Facility creeks/springs			
• Surface soil		Incidental ingestion of contaminated sediment in Facility creeks	High	Yes	
• Surface water/ Sediment (Boggs Creek)		Dermal contact with contaminated sediment in Facility creeks	High	Yes	
• Groundwater		Ingestion of contaminated fish from Facility creeks	High	Yes	
		Ingestion of contaminated beef/milk	Low	No	Fishing by these receptors may occur; however, the Facility creeks are not viable recreational sources.
		Ingestion of contaminated vegetables	High	Yes	High potential for livestock to be raised in rural area.
		Ingestion of venison/turkey	High	Yes	Potential high for residents to consume garden vegetables grown at home.
			Medium	Yes	High potential for hunting in rural area.

TABLE 4-6

NUTRIENT SCREENING VALUES

Nutrient	RDA[A] (mg/kg-d)[B]	Nutrient Screening Value (ppm)	
		Soil/Sediment	Water
Calcium	14	1,000,000	510
Magnesium	5.7	1,000,000	200
Iron	0.26	70,000	9.4
Potassium	0.57	150,000	20
Sodium	20[C]	1,000,000	730

[A] U.S. Recommended Daily Allowance (USEPA, 1994a).
[B] Milligrams per kilogram per day.
[C] See text.

TABLE 4-7

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - ABG PROPER SURFACE SOIL
Page 1 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
1,3-Dinitrobenzene	1/87	0.128	0.25	0.125	0.125	0.125
1,3,5-Trinitrobenzene	27/87	0.065 - 12.6	0.25	0.30	0.385	0.385
2-Amino-4,6-dinitrotoluene	21/62	0.01 - 5.65	0.25	0.245	0.324	0.324
2,3,7,8-TCDD equivalents	3/3	1.56E-06 - 2.47E-06	NA	2.0E-06	3.9E-06	2.47E-06
2,4-Dinitrotoluene	19/87	0.015 - 16.7	0.25	0.245	0.312	0.312
2,4,6-Trinitrotoluene	45/87	0.02 - 1,640	0.25 - 0.65	1.69	3.37	3.37
2,6-Dinitrotoluene	7/62	0.1 - 0.575	0.26	0.145	0.154	0.154
4-Amino-2,6-dinitrotoluene	27/62	0.06 - 8.2	0.25	0.26	0.335	0.335
Aluminum	18/18	2,490 - 11,800	NA	6,544	7,920	7,920
Antimony	12/18	4.9 - 47.8	4.3 - 5.1	9.3	15.1	15.1
Arsenic	18/18	2.4 - 24.3	NA	7.3	10	10
Barium	18/18	33 - 1,500	NA	313	740	740
Cadmium	5/18	1.45 - 15.8	1.1 - 1.3	2.2	3.7	3.7
Chromium	18/18	4.6 - 39.8	NA	14.4	19.2	19.2
Cobalt	18/18	2.7 - 22.1	NA	9.5	13	13

TABLE 4-7 (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - ABG PROPER SURFACE SOIL
Page 2 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
Copper	18/18	4.6 - 5,860	NA	400	1,365	1,365
Di-n-butyl phthalate	4/4	0.03 - 0.11	NA	0.08	0.123	0.11
HMX	49/87	0.035 - 223	2.2	7.8	13.9	13.9
Lead	18/18	6.0 - 4,180	NA	464	3,686	3,686
Manganese	18/18	128 - 6,340	NA	974	1,756	1,756
Mercury	4/18	0.20 - 1.9	0.11 - 0.13	0.31	0.58	0.58
Nickel	18/18	6.8 - 33.1	NA	16.3	21.3	21.3
RDX	36/87	0.035 - 1,820	1.0	4.9	9.74	9.74
Silver	13/18	1.3 - 153	1.1 - 1.2	10	11.9	11.9
Tetryl	3/87	0.115 - 0.679	0.25 - 0.65	0.321	0.338	0.338
Thallium	3/18	0.23 - 0.28	0.22 - 0.26	0.14	0.16	0.16
Vanadium	18/18	6.2 - 24.7	NA	14.7	16.7	16.7
Zinc	18/18	31.5 - 24,800	NA	1,579	2,428	2,428

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable. NC = Not calculated due to insufficient data.

TABLE 4-8

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - JEEP TRAIL SURFACE SOIL
Page 1 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
2,4-Dinitrotoluene	3/5	0.099 - 38.0	0.38 - 0.42	7.8	6.8E+06	38
2,6-Dinitrotoluene	2/5	0.039 - 4.0	0.38 - 0.42	0.93	907	4.0
Aluminum	5/5	3,810 - 9,050	NA	6,399	8,318	8,318
Arsenic	5/5	6.0 - 14.3	NA	8.7	13.8	13.8
Barium	5/5	121 - 2,720	NA	702	35,818	2,720
Cadmium	4/5	0.78 - 1.75	0.23	0.93	1.5	1.5
Copper	5/5	19.2 - 91.6	NA	45.9	164	91.6
Cyanide	5/5	0.2 - 0.45	NA	0.36	0.47	0.45
Diethyl phthalate	1/5	0.023	0.38 - 0.46	0.17	0.25	0.023
Di-n-butyl phthalate	5/5	0.024 - 28.0	NA	5.8	4.1E+09	28.0
HMX	3/5	0.45 - 2.0	2.2	1.1	2.8	2.0
Nickel	5/5	11.5 - 28.2	NA	15.9	25.7	25.7
N-Nitrosodiphenylamine	2/5	0.048 - 8.1	0.38 - 0.42	1.75	16,057	8.1
RDX	1/5	1.42	1.0	0.68	1.37	1.37
Selenium	2/5	0.61 - 0.68	0.48 - 0.50	0.41	0.62	0.62
Zinc	5/5	71.6 - 301	NA	160	385	301

TABLE 4-8 (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - JEEP TRAIL SURFACE SOIL
Page 2 of 2

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable. NC = Not calculated due to insufficient data.

TABLE 4-9

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - ABG PROPER SURFACE/SUBSURFACE SOIL COMBINED
Page 1 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
1,3-Dinitrobenzene	1/131	0.128	0.25 - 25	0.219	0.375	0.128
1,3,5-Trinitrobenzene	31/131	0.065 - 37.5	0.25	0.289	0.351	0.351
2-Amino-4.6-dinitrotoluene	24/88	0.01 - 5.65	0.25 - 25	0.25	0.315	0.315
2,3,7,8-TCDD equivalents	3/3	1.56E-06 - 2.47E-06	NA	2.0E-06	3.9E-06	2.47E-06
2,4-Dinitrotoluene	21/131	0.015 - 16.7	0.25 - 25	0.219	0.259	0.259
2,4,6-Trinitrotoluene	57/131	0.02 - 2,030	0.25 - 0.65	1.73	3.0	3.0
2,6-Dinitrotoluene	7/88	0.1 - 0.575	0.26 - 26	0.167	0.186	0.186
4-Amino-2,6-dinitrotoluene	32/88	0.02 - 8.2	0.25 - 25	0.264	0.337	0.337
Acetone	1/5	0.028	0.011 - 0.015	0.011	0.037	0.028
Aluminum	22/22	2,490 - 11,800	NA	6,573	7,742	7,742
Antimony	16/22	4.9 - 47.8	4.3 - 5.1	9.6	14.7	14.7
Arsenic	22/22	2.2 - 23.3	NA	6.8	9	9
Barium	22/22	33 - 1,500	NA	299	583	583
Bis(2-ethylhexyl)phthalate	1/5	0.28	0.37 - 0.41	0.21	0.26	0.26
Cadmium	6/22	1.1 - 15.8	1.1 - 1.3	1.9	2.7	2.7

TABLE 4-9 (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - ABG PROPER SURFACE/SUBSURFACE SOIL COMBINED
Page 2 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
Chromium	22/22	4.6 -39.8	NA	13.9	17.2	17.2
Cobalt	22/22	2.7 - 22.1	NA	9.5	12.2	12.2
Copper	22/22	4.6 - 5,860	NA	339	667	667
Di-n-butyl phthalate	5/5	0.03 - 0.18	NA	0.1	0.15	0.15
HMX	62/131	0.035 - 232	2.2	5.53	8.3	8.3
Lead	22/22	6.0 - 4,180	NA	394	1,743	1,743
Manganese	22/22	128 - 6,340	NA	1,140	2,054	2,054
Mercury	5/22	0.15 - 1.9	0.11 - 0.13	0.27	0.39	0.39
Nickel	22/22	6.8 - 46.0	NA	18.2	23.4	23.4
RDX	46/131	0.035 - 1,820	0.1 - 1.0	3.4	5.3	5.3
Silver	17/22	1.3 - 153	1.1 - 1.2	8.7	7.4	7.4
Tetryl	4/131	0.115 - 0.776	0.25 - 65	0.568	0.972	0.776
Thallium	3/22	0.23 - 0.28	0.21 - 0.27	0.14	0.15	0.15
Vanadium	22/22	6.2 - 24.7	NA	14.5	16	16
Zinc	22/22	31.5 - 24,800	NA	1,358	1,791	1,791

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-10

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - LITTLE SULPHUR CREEK SURFACE WATER (ABG)

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
2,4-Dinitrotoluene	2/10	0.004 - 0.009	0.005 - 0.02	0.007	0.013	0.009
Aluminum	4/6	0.106 - 2.21	0.05	0.99	2,772	2.21
Arsenic	2/6	0.0019 - 0.0031	0.001 - 0.004	0.0016	0.0024	0.0024
Barium	6/6	0.1125 - 0.2235	NA	0.1513	0.2193	0.2193
Cadmium	1/6	0.0022	0.001 - 0.002	0.001	0.0022	0.0022
Chromium	1/6	0.0023	0.001 - 0.005	0.00213	0.00280	0.0023
Copper	3/6	0.0067 - 0.0292	0.002 - 0.005	0.0078	0.014	0.014
Diethylphthalate	1/4	0.0007	0.005 - 0.01	0.0027	0.0048	0.0007
Di-n-butylphthalate	1/4	0.0011	0.001 - 0.01	0.0023	0.125	0.0011
HMX	5/10	0.014 - 0.045	0.013 - 0.02	0.019	0.0336	0.0336
Lead	5/6	0.0013 - 0.13	0.001	0.033	449	0.13
Manganese	6/6	0.0124 - 0.2175	NA	0.092	0.79	0.2175
Methylene chloride	1/4	0.013	0.003 - 0.01	0.006	0.15	0.013
RDX	2/10	0.024 - 0.037	0.014 - 0.02	0.013	0.02	0.02
Zinc	2/6	0.0952 - 0.2	0.005 - 0.021	0.05	61	0.2

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-11

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - LITTLE SULPHUR CREEK SEDIMENT (ABG)
Page 1 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
1,3,5-Trinitrobenzene	5/12	0.05 - 0.20	0.25	0.114	0.143	0.143
2-Butanone	2/4	0.001 - 0.008	0.011 - 0.012	0.0051	0.0086	0.008
2,4-Dinitrotoluene	3/12	0.105 - 0.530	0.25	0.178	0.264	0.264
2,4,6-Trinitrotoluene	10/12	0.094 - 1.063	0.25	0.343	0.712	0.712
Acetone	3/4	0.007 - 0.024	0.012	0.011	0.066	0.024
Aluminum	6/6	7,130 - 25,500	NA	13,093	26,991	25,500
Antimony	6/6	1.4 - 29.8	NA	15.9	25.0	25.0
Arsenic	6/6	6.6 - 62.0	NA	21.3	71.8	62.0
Barium	6/6	67.2 - 2,030	NA	519	6,502	2,030
Cadmium	2/6	0.24 - 6.1	0.22 - 1.4	1.2	40.4	6.1
Copper	6/6	24.7 - 318	NA	76.9	485	318
Cyanide	2/6	0.39 - 0.40	0.52 - 0.63	0.319	0.381	0.381
Di-n-butylphthalate	4/4	0.032 - 0.79	NA	0.188	1,347	0.79
HMX	8/12	0.245 - 10.2	0.90 - 2.2	1.5	3.7	3.7
Lead	6/6	17.7 - 284	NA	109	915	284
N-Nitrosodiphenylamine	1/6	0.085	0.35 - 0.38	0.169	0.203	0.085

TABLE 4-11 (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - LITTLE SULPHUR CREEK SEDIMENT (ABG)
Page 2 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
RDX	2/12	0.405 - 1.78	0.90 - 1.0	0.567	0.726	0.726
Silver	4/6	2.4 - 3.8	0.29 - 0.31	2.13	3.45	3.45
Vanadium	6/6	25.3 - 58.3	NA	37.0	49.7	49.7
Zinc	6/6	99.8 - 1,060	NA	395	3,687	1,060

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable. NC = Not calculated due to insufficient data.

TABLE 4-12A

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - ON-SITE SPRING WATER - ABG

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
1,3,5-Trinitrobenzene	1/3	0.00081	0.002	0.0009	0.00125	0.00081
2,4,6-Trinitrotoluene	1/3	0.002	0.002	0.0013	0.0060	0.002
Aldrin	1/3	0.0011	0.000025	0.0003	3.2E+16	0.0011
Aluminum	3/3	0.0684 - 0.92	NA	0.456	1.4E+07	0.92
Arsenic	3/3	0.0025 - 0.0032	NA	0.0029	0.0038	0.0032
Barium	3/3	0.06945 - 0.123	NA	0.099	0.237	0.123
Bis(2-ethylhexyl)phthalate	1/3	0.0037	0.01	0.0046	0.0069	0.0037
Chromium	1/3	0.0031	0.001 - 0.002	0.0015	8.68	0.0031
Cobalt	1/3	0.0031	0.001	0.0013	64.5	0.0031
Copper	2/3	0.0015 - 0.0066	0.001	0.0028	22,347	0.0066
HMX	3/3	0.003 - 0.0383	NA	0.024	1.4E+06	0.0383
Manganese	3/3	0.003 - 0.1175	NA	0.038	1.2E+13	0.1175
Mercury	1/3	0.00069	0.0001	0.00028	78.7	0.00069
Methylene chloride	2/3	0.0016 - 0.0034	0.004	0.0023	0.015	0.0034
Nickel	2/3	0.0014 - 0.006	0.001	0.0026	6,417	0.006
RDX	3/3	0.0084 - 0.156	NA	0.079	1.1E+08	0.156

TABLE 4-12A (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - ON-SITE SPRING WATER - ABG
Page 2 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
Selenium	1/3	0.0021	0.002	0.0014	0.01	0.0021
Thallium	1/3	0.0045	0.002	0.002	3.3	0.0045
Trichloroethylene	1/3	0.003	0.005	0.0027	0.0034	0.003
Vanadium	1/3	0.0048	0.001	0.0017	53,973	0.0048
Xylene	2/3	0.0023 - 0.0024	0.005	0.0024	0.0026	0.0024
Zinc	1/3	0.0139	0.003 - 0.006	0.006	1,776	0.0139

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-12B

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - OFF-SITE SPRING WATER - ABG

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
Aluminum	2/2	0.0223 - 0.224	NA	0.123	0.76	0.224
Antimony	1/2	0.0042	0.003	0.0029	0.011	0.0042
Barium	2/2	0.0545 - 0.0764	NA	0.065	0.135	0.0764
Carbon disulfide	1/2	0.002	0.01	0.0035	0.013	0.002
Copper	1/2	0.0016	0.001	0.001	0.005	0.0016
Di-n-butylphthalate	2/2	0.0006 - 0.0008	NA	0.0007	0.0013	0.0008
Manganese	2/2	0.0019 - 0.015	NA	0.008	0.05	0.015
Nickel	1/2	0.002	0.001	0.001	0.006	0.002
Zinc	2/2	0.0061 - 0.0085	NA	0.007	0.015	0.0085

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-12C

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - ON-SITE SPRING A - ABG

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
1,3,5-Trinitrobenzene	1/1	0.00081	NA	NA	NA	0.00081
2,4,6-Trinitrotoluene	1/1	0.002	NA	NA	NA	0.002
Aldrin	1/1	0.0011	NA	NA	NA	0.0011
Aluminum	1/1	0.0684	NA	NA	NA	0.0684
Arsenic	1/1	0.0032	NA	NA	NA	0.0032
Barium	1/1	0.123	NA	NA	NA	0.123
Copper	1/1	0.0015	NA	NA	NA	0.0015
HMX	1/1	0.024	NA	NA	NA	0.024
Manganese	1/1	0.0092	NA	NA	NA	0.0092
Nickel	1/1	0.0014	NA	NA	NA	0.0014
RDX	1/1	0.057	NA	NA	NA	0.057
Selenium	1/1	0.0021	NA	NA	NA	0.0021
Thallium	1/1	0.0045	NA	NA	NA	0.0045
Xylene	1/1	0.0023	NA	NA	NA	0.0023

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-13

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (BEAVER BEND) - ABG

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
Arsenic	2/3	0.0063 - 0.0098	0.005	0.0062	0.0124	0.0098
Benzo(a)anthracene	1/3	0.0012	0.01	0.0037	0.0074	0.0012
Bis(2-ethylhexyl) phthalate	1/3	0.0022	0.01	0.004	0.007	0.022
Chrysene	1/3	0.0012	0.01	0.0037	0.0074	0.0012
N-Nitrosodiphenylamine	2/3	0.0014 - 0.0015	0.01	0.0026	0.006	0.0015
Zinc	3/3	0.01 - 0.015	NA	0.012	0.016	0.015

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-14

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (BEECH CREEK AQUIFER) - ABG PROPER

Page 1 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
1,2-Dichloroethane	4/16	0.0011 - 0.018	0.005 - 0.05	0.005	0.009	0.009
1,2-Dichloroethylene	1/16	0.034	0.005 - 0.12	0.007	0.017	0.017
1,3,5-Trinitrobenzene	2/17	0.0042 - 0.0059	0.001 - 0.01	0.002	0.003	0.003
2-Amino-4,6-dinitrotoluene	1/2	0.012	0.001	0.0063	0.042	0.012
2-Butanone	5/16	0.0023 - 0.023	0.01 - 0.25	0.015	0.038	0.023
Acetone	6/16	0.0035 - 0.0066	0.01 - 0.25	0.011	0.022	0.0066
Aldrin	2/16	0.00018 - 0.0012	0.00005	0.00006	0.00014	0.00014
Aluminum	6/16	0.24 - 4.1	0.2	0.64	2.6	2.6
Arsenic	5/16	0.0054 - 0.021	0.005	0.005	0.007	0.007
Barium	2/16	0.13 - 0.43	0.1	0.07	0.099	0.099
Benzyl alcohol	1/16	0.002	0.01 - 0.02	0.005	0.006	0.002
Bis(2-ethylhexyl)phthalate	5/16	0.0012 - 0.034	0.01	0.007	0.011	0.011
Chromium	1/16	0.033	0.03	0.016	0.018	0.018
cis-1,2-Dichloroethylene	1/1	0.049	NA	NA	NA	0.049
Cyanide	1/16	0.011	0.01	0.005	0.006	0.006
Heptachlor epoxide	3/16	0.000078 - 0.00024	0.00005	0.00004	0.00007	0.00007

TABLE 4-14 (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (BEECH CREEK AQUIFER) - ABG PROPER
Page 2 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
HMX	8/17	0.0031 - 0.0347	0.001 - 0.002	0.0086	0.0358	0.0347
Lead	8/16	0.005 - 0.039	0.005 - 0.01	0.01	0.021	0.021
Manganese	15/16	0.015 - 1.2	0.01	0.357	2.4	1.2
Mercury	2/16	0.00022 - 0.0012	0.0002 - 0.00022	0.00015	0.00022	0.00022
Methylene chloride	8/16	0.0013 - 0.018	0.004 - 0.005	0.003	0.0046	0.0046
Nitrobenzene	1/17	0.0014	0.001 - 0.002	0.00098	0.001	0.001
N-Nitrosodiphenylamine	3/16	0.0012 - 0.0015	0.01 - 0.02	0.0046	0.0055	0.0015
RDX	9/17	0.02 - 0.305	0.001 - 0.002	0.0708	1.65	0.305
Tetrachloroethylene	1/16	0.0012	0.005 - 0.05	0.0033	0.0048	0.0012
trans-1,2-Dichloroethylene	1/1	0.006	NA	NA	NA	0.006
Trichloroethylene	11/16	0.0025 - 3.55	0.005	0.203	10.7	3.55
Vinyl chloride	1/16	0.002	0.01 - 0.10	0.0066	0.0097	0.0097
Zinc	13/16	0.022 - 0.20	0.01	0.067	0.18	0.18

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-15

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (GOLCONDA AQUIFER) - ABG
Page 1 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
Aluminum	2/2	1.06 - 55.8	NA	28.4	201	55.8
Antimony	1/2	0.052	0.008	0.028	0.179	0.052
Arsenic	2/2	0.00345 - 0.074	NA	0.0387	0.261	0.074
Barium	2/2	0.1125 - 1.47	NA	0.791	5.07	1.47
Beryllium	1/2	0.0075	0.001	0.004	0.026	0.0075
Chromium	2/2	0.00615 - 0.0869	NA	0.046	0.301	0.0869
Cobalt	2/2	0.0065 - 0.137	NA	0.072	0.48	0.137
Copper	1/2	0.107	0.005	0.055	0.38	0.107
HMX	1/1	0.002	NA	NA	NA	0.002
Lead	2/2	0.0019 - 0.16	NA	0.08	0.58	0.16
Manganese	2/2	0.343 - 11.5	NA	5.9	41	11.5
Mercury	1/2	0.00064	0.0001	0.00037	0.002	0.00065
Nickel	2/2	0.023 - 0.332	NA	0.177	1.15	0.332
RDX	2/1	0.00115	NA	NA	NA	0.00115
Silver	1/2	0.0095	0.005	0.006	0.028	0.0095

TABLE 4-15 (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (GOLCONDA AQUIFER) - ABG
Page 2 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
Vanadium	1/2	0.0857	0.005	0.044	0.307	0.0857
Zinc	2/2	0.03 - 0.454	NA	0.24	1.6	0.454

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-16

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (ALLUVIUM) - ABG
Page 1 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
1,1-Dichloroethylene	1/2	0.007	0.005	0.00475	0.019	0.007
1,1,2-Trichlorethane	1/2	0.0545	0.005	0.0285	0.193	0.0545
1,1,2,2-Tetrachlorethane	1/2	0.505	0.005	0.254	1.84	0.505
1,2-Dichloroethylene (total)	1/2	1.15	0.005	0.576	4.2	1.15
4-Nitrophenol	1/2	0.001	0.05	0.013	0.089	0.001
Aluminum	3/4	0.715 - 1.95	0.20	1.16	2.23	1.95
Arsenic	4/4	0.0023 - 0.011	NA	0.006	0.04	0.011
Barium	3/4	0.059 - 0.072	0.1	0.0607	0.075	0.072
Bis(2-ethylhexyl)phthalate	1/2	0.0012	0.01	0.003	0.015	0.0012
Cadmium	1/4	0.0099	0.001 - 0.002	0.0026	2.23	0.0099
Chloroethane	1/2	0.007	0.01	0.006	0.01	0.007
Chloroform	1/2	0.001	0.005	0.002	0.006	0.001
Chromium	2/4	0.0062 - 0.0214	0.005	0.011	0.0213	0.0213
Cobalt	1/4	0.004	0.005 - 0.04	0.007	0.34	0.004
Copper	3/4	0.0073 - 0.0152	0.03	0.0125	0.017	0.0152
Disulfoton	1/1	0.0012	NA	NA	NA	0.0012

TABLE 4-16 (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (ALLUVIUM) - ABG
Page 2 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
Lead	3/4	0.0051 - 0.0076	0.01	0.0057	0.0076	0.0076
Manganese	4/4	0.562 - 5.81	NA	2.27	126	5.81
Mercury	1/4	0.00051	0.0002 - 0.007	0.00027	0.00051	0.00051
Methylene chloride	1/2	0.0012	0.016	0.0046	0.026	0.0012
Nickel	1/4	0.0239	0.02 - 0.04	0.016	0.0243	0.0239
Nitrobenzene	1/4	0.0006	0.001 - 0.002	0.00073	0.001	0.0006
Silver	1/4	0.0018	0.005 - 0.03	0.005	0.234	0.0018
Tetrachloroethylene	1/2	0.009	0.005	0.00575	0.026	0.009
Trichloroethylene	1/2	2.3	0.005	1.2	8.4	2.3
Vanadium	2/4	0.0051 - 0.0068	0.005 - 0.04	0.0086	0.0178	0.0068
Vinyl chloride	1/2	0.018	0.01	0.012	0.05	0.018
Xylene	1/2	0.0029	0.01	0.004	0.01	0.0029
Zinc	2/4	0.022 - 0.0242	0.024 - 0.027	0.018	0.034	0.0242

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-17

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (BEECH CREEK AQUIFER) - JEEP TRAIL
Page 1 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
1,1,2,2-Tetrachloroethane	2/4	0.003 - 0.012	0.001 - 0.01	0.006	9.6	0.012
1,2-Dichloroethylene (total)	2/3	0.005 - 0.008	0.01	0.006	0.009	0.008
2,4,6-Trinitrotoluene	2/6	0.00055 - 0.0078	0.001 - 0.006	0.0032	0.029	0.0078
2,6-Dinitrotoluene	1/6	0.00078	0.001 - 0.009	0.003	0.025	0.00078
4-Amino-2,6-dinitrotoluene	2/3	0.00093 - 0.0051	0.001	0.0022	0.0064	0.0051
Aluminum	4/4	14.7 - 51.4	NA	32.8	57.3	51.4
Antimony	1/4	0.011	0.003 - 0.006	0.004	0.094	0.011
Arsenic	4/4	0.021 - 0.14	NA	0.068	0.135	0.135
Barium	4/4	0.161 - 2.3	NA	0.91	257	2.3
Beryllium	4/4	0.0014 - 0.008	NA	0.004	0.08	0.008
Bis(2-ethylhexyl)phthalate	1/4	0.0017	0.01	0.004	0.016	0.0017
Cadmium	3/4	0.0014 - 0.0069	0.003	0.004	0.0074	0.0069
Chromium	4/4	0.0232 - 0.0825	NA	0.06	0.092	0.0825
Cobalt	4/4	0.0073 - 0.0542	NA	0.036	1.57	0.0542
Copper	3/4	0.0191 - 0.0799	0.027	0.046	1.73	0.0799
Cyclohexane	1/1	0.12	NA	NA	NA	0.12

TABLE 4-17 (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (BEECH CREEK AQUIFER) - JEEP TRAIL
Page 2 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
Di-n-butylphthalate	1/4	0.001	0.005 - 0.01	0.003	0.0057	0.001
HMX	4/6	0.0008 - 0.16	0.013	0.07	127	0.16
Lead	4/4	0.027 - 0.229	NA	0.11	5.8	0.229
Manganese	4/4	2.0 - 14.7	NA	6.5	334	14.7
Nickel	4/4	0.064 - 0.285	NA	0.14	1.5	0.285
RDX	4/6	0.025 - 0.31	0.014	0.082	5.6	0.31
Trichloroethylene	4/4	0.0003 - 0.016	NA	0.008	0.0165	0.016
Vanadium	4/4	0.0264 - 0.116	NA	0.079	0.13	0.116
Zinc	4/4	0.161 - 0.901	NA	0.498	0.948	0.901

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-18

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (BEECH CREEK AQUIFER) - ABG PROPER - WELL 03C28

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
Acetone	1/1	0.0035	NA	NA	NA	0.0035
Aluminum	1/1	1.2	NA	NA	NA	1.2
Arsenic	1/1	0.009	NA	NA	NA	0.009
Barium	1/1	0.43	NA	NA	NA	0.43
Benzyl alcohol	1/1	0.002	NA	NA	NA	0.002
Bis(2-ethylhexyl)phthalate	1/1	0.0018	NA	NA	NA	0.0018
Lead	1/1	0.034	NA	NA	NA	0.034
Mercury	1/1	0.0012	NA	NA	NA	0.0012
Methylene chloride	1/1	0.0015	NA	NA	NA	0.0015
Zinc	1/1	0.089	NA	NA	NA	0.089

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-19

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - ORR SURFACE SOIL
Page 1 of 3

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
1,3,5-Trinitrobenzene	2/23	0.159 - 0.183	0.25	0.128	0.131	0.131
2,4-Dinitrotoluene	1/36	1.7	0.25	0.169	0.243	0.243
2,4,6-Trinitrotoluene	4/36	0.147 - 3.08	0.25 - 2.49	0.192	0.243	0.243
Acenaphthene	1/4	0.13	0.38 - 0.42	0.184	0.227	0.13
Aluminum	7/7	5,050 - 6,990	NA	5,980	6,582	6,582
Anthracene	1/4	0.19	0.38 - 0.42	0.199	0.211	0.19
Antimony	1/7	5.3	0.67 - 5.1	1.94	3.27	3.27
Arsenic	7/7	3.2 - 9.1	NA	6.3	7.6	7.6
Barium	7/7	49.4 - 273	NA	148	313	273
Benzo(a)anthracene	2/4	0.077 - 2.5	0.41 - 0.42	0.62	4,320	2.5
Benzo(a)pyrene	2/4	0.1 - 2.8	0.41 - 0.42	0.669	4,072	2.8
Benzo(b)fluoranthene	2/4	0.099 - 3.7	0.41 - 0.42	0.807	21,545	3.7
Benzo(g,h,i)perylene	2/4	0.088 - 2.0	0.41 - 0.42	0.539	904	2.0
Benzo(k)fluoranthene	2/4	0.098 - 1.4	0.41 - 0.42	0.434	95	1.4
Beryllium	7/7	0.37 - 1.2	NA	0.76	0.98	0.98
Carbazole	1/4	0.19	0.38 - 0.42	0.2	0.21	0.19

TABLE 4-19 (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - ORR SURFACE SOIL
Page 2 of 3

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
Chromium	7/7	8.2 - 18.6	NA	11.9	15	15
Chrysene	2/4	0.1 - 3.1	0.41 - 0.42	0.72	10,483	3.1
Copper	7/7	9.9 - 35.9	NA	18.8	29.4	29.4
Cyanide	1/5	0.48	0.57 - 0.63	0.337	0.437	0.437
Dibenzofuran	1/4	0.04	0.38 - 0.42	0.16	0.26	0.04
Dibenz(a,h)anthracene	2/4	0.019 - 0.84	0.41 - 0.42	0.36	7,875	0.84
Di-n-butylphthalate	2/4	0.021 - 0.077	0.41 - 0.75	0.18	120	0.077
Fluoranthene	2/4	0.099 - 3.1	0.41 - 0.42	0.72	10,674	3.1
Fluorene	1/4	0.074	0.38 - 0.42	0.17	0.246	0.074
Indeno(1,2,3-cd)pyrene	2/4	0.081 - 2.2	0.41 - 0.42	0.57	2,458	2.2
Lead	7/7	20.2 - 68.3	NA	35.8	59.1	59.1
Manganese	7/7	357 - 1,660	NA	878	1,624	1,624
Naphthalene	1/4	0.1	0.38 - 0.42	0.18	0.237	0.1
Phenanthrene	2/4	0.028 - 0.91	0.41 - 0.42	0.357	1,747	0.91
Pyrene	2/4	0.11 - 2.9	0.41 - 0.42	0.687	3,965	2.9
Silver	1/7	1.6	0.22 - 1.3	0.542	3.4	1.6
Thallium	2/7	0.56 - 0.74	0.23 - 0.46	0.277	0.81	0.74

TABLE 4-19 (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - ORR SURFACE SOIL
Page 3 of 3

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
Vanadium	7/7	14.4 - 24.1	NA	18	20.8	20.8
Zinc	7/7	25.9 - 72.8	NA	41	56.6	56.6

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable. NC = Not calculated due to insufficient data.

TABLE 4-20

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - ORR SURFACE/SUBSURFACE SOIL COMBINED
Page 1 of 3

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
1,3,5-Trinitrobenzene	2/50	0.159 - 0.183	0.25	0.127	0.129	0.129
2,4-Dinitrotoluene	1/53	1.7	0.25	0.155	0.204	0.204
2,4,6-Trinitrotoluene	4/53	0.147 - 3.08	0.25 - 2.49	0.210	0.31	0.31
Acenaphthene	1/4	0.13	0.38 - 0.42	0.184	0.227	0.13
Aluminum	9/9	5,050 - 8,930	NA	6,244	7,055	7,055
Anthracene	1/4	0.19	0.38 - 0.42	0.199	0.211	0.19
Antimony	2/9	5.3 - 7.8	0.67 - 5.1	2.9	15.4	7.8
Arsenic	9/9	3.2 - 9.1	NA	6.5	7.5	7.5
Barium	9/9	48.5 - 273	NA	138	250	250
Benzo(a)anthracene	2/4	0.077 - 2.5	0.41 - 0.42	0.62	4,320	2.5
Benzo(a)pyrene	2/4	0.1 - 2.8	0.41 - 0.42	0.669	4,072	2.8
Benzo(b)fluoranthene	2/4	0.099 - 3.7	0.41 - 0.42	0.807	21,545	3.7
Benzo(g,h,i)perylene	2/4	0.088 - 2.0	0.41 - 0.42	0.539	904	2.0
Benzo(k)fluoranthene	2/4	0.098 -1.4	0.41 - 0.42	0.434	95	1.4
Beryllium	9/9	0.37 - 1.2	NA	0.75	0.93	0.93
Carbazole	1/4	0.19	0.38 - 0.42	0.2	0.21	0.19

TABLE 4-20 (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - ORR SURFACE/SUBSURFACE SOIL COMBINED
Page 2 of 3

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
Chromium	9/9	8.2 - 18.6	NA	12.4	15.2	15.2
Chrysene	2/4	0.1 - 3.1	0.41 - 0.42	0.72	10,483	3.1
Copper	9/9	6.8 - 35.9	NA	16.6	25.2	25.2
Cyanide	1/7	0.48	0.57 - 0.63	0.33	0.38	0.38
Dibenzofuran	1/4	0.04	0.38 - 0.42	0.16	0.26	0.04
Dibenz(a,h)anthracene	2/4	0.019 - 0.84	0.41 - 0.42	0.36	7,875	0.84
Di-n-butylphthalate	2/4	0.021 - 0.077	0.41 - 0.75	0.18	120	0.077
Fluoranthene	2/4	0.099 - 3.1	0.41 - 0.42	0.72	10,674	3.1
Fluorene	1/4	0.074	0.38 - 0.42	0.17	0.246	0.074
Indeno(1,2,3-cd)pyrene	2/4	0.081 - 2.2	0.41 - 0.42	0.57	2,458	2.2
Lead	9/9	14.7 - 68.3	NA	31.5	50	50
Manganese	9/9	357 - 1,660	NA	899	1,356	1,356
Naphthalene	1/4	0.10	0.38 - 0.42	0.18	0.237	0.1
Phenanthrene	2/4	0.028 - 0.91	0.41 - 0.42	0.357	1,747	0.91
Pyrene	2/4	0.11 - 2.9	0.41 - 0.42	0.687	3,965	2.9
Silver	2/9	1.6 - 2.0	0.22 - 1.3	0.74	3.1	2.0
Thallium	3/9	0.26 - 0.74	0.23 - 0.46	0.26	0.54	0.54

TABLE 4-20 (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - ORR SURFACE/SUBSURFACE SOIL COMBINED
Page 3 of 3

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
Vanadium	9/9	14.4 - 24.3	NA	19	21.8	21.8
Zinc	9/9	24.9 - 72.8	NA	39	50.8	50.8

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable. NC = Not calculated due to insufficient data.

TABLE 4-21

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - TURKEY CREEK SURFACE WATER (ORR)

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
Aluminum	1/2	0.0286	0.167	0.0561	0.229	0.0286
Butylbenzylphthalate	1/2	0.0006	0.01	0.0028	0.0167	0.0006
Cobalt	1/2	0.0013	0.001	0.0009	0.0034	0.0013
Copper	2/2	0.0013 - 0.0037	NA	0.0025	0.01	0.0037
Vanadium	1/2	0.0012	0.001	0.0009	0.0031	0.0012
Zinc	1/2	0.0115	0.002	0.0062	0.0396	0.0115

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-22

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - TURKEY CREEK SEDIMENT (ORR)
Page 1 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
2-Butanone	2/2	0.006 - 0.007	NA	0.0065	0.0097	0.007
2,4-Dinitrotoluene	1/2	0.13	0.46	0.18	0.50	0.13
Acetone	1/2	0.025	0.026	0.019	0.057	0.025
Aluminum	2/2	3,020 - 3,765	NA	3,393	5,744	3,765
Arsenic	2/2	6.5 - 8.7	NA	7.6	14.5	8.7
Barium	2/2	44.8 - 59.9	NA	52.3	99.8	59.9
Benzo(b)fluoranthene	1/2	0.044	0.46	0.14	0.72	0.044
Beryllium	2/2	0.75 - 0.78	NA	0.77	0.86	0.78
Cadmium	1/2	0.685	0.31	0.42	2.1	0.685
Chromium	2/2	12.2 - 12.5	NA	12.4	13.3	12.5
Chrysene	1/2	0.03	0.46	0.13	0.76	0.03
Cobalt	2/2	9.25 - 10.3	NA	9.8	13.1	10.3
Copper	2/2	7.7 - 11.6	NA	9.6	21.8	11.6
Di-n-butylphthalate	1/2	0.098	0.46	0.16	0.58	0.098
Fluoranthene	1/2	0.0335	0.46	0.13	0.75	0.0335
Lead	2/2	9.9 - 11.1	NA	10.5	14.3	11.1

TABLE 4-22 (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - TURKEY CREEK SEDIMENT (ORR)
Page 2 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
Manganese	2/2	167 - 477	NA	322	1,300	477
Nickel	2/2	15.7 - 16.7	NA	16.2	19.5	16.7
N-Nitrosodiphenylamine	1/2	0.023	0.46	0.13	0.78	0.023
Pyrene	1/2	0.0335	0.46	0.13	0.75	0.0335
Selenium	2/2	0.74 - 0.95	NA	0.85	1.5	0.95
Vanadium	2/2	14.4 - 14.6	NA	14.5	14.9	14.6
Zinc	2/2	34.7 - 47.2	NA	40.9	80	47.2

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-23

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (BEECH CREEK AQUIFER) - ORR

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
2,4,6-Trinitrotoluene	2/10	0.0042 - 0.0085	0.002 - 0.02	0.005	0.018	0.0085
3,3'-Dichlorobenzidine	1/7	0.0013	0.01 - 0.02	0.007	0.01	0.0013
Acetone	3/7	0.012 - 0.018	0.01	0.009	0.0137	0.0137
Aluminum	3/8	0.0559 - 8.63	0.015 - 0.2	0.71	300	8.63
Antimony	1/7	0.0034	0.003 - 0.2	0.093	98.5	0.0034
Arsenic	2/8	0.0036 - 0.0277	0.001 - 0.005	0.0045	0.0278	0.0277
Benzo(a)anthracene	1/7	0.0018	0.01	0.0045	0.0067	0.0018
Beryllium	1/8	0.0016	0.001 - 0.002	0.0009	0.00114	0.00114
Bis(2-ethylhexyl)phthalate	3/7	0.001 - 0.0021	0.01	0.0036	0.0094	0.0021
Butylbenzylphthalate	3/7	0.0015 - 0.0036	0.01	0.004	0.0051	0.0036
Chromium	1/8	0.0275	0.001 - 0.03	0.0114	0.0177	0.0177
Chrysene	1/7	0.0016	0.01	0.0045	0.007	0.0016
Cobalt	1/8	0.02	0.001 - 0.04	0.019	0.87	0.02
Copper	1/8	0.0269	0.001 - 0.03	0.011	0.0175	0.0175
Heptachlor epoxide	2/6	0.00062 - 0.002	0.000025	0.00036	0.63	0.002

TABLE 4-23
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (BEECH CREEK AQUIFER) - ORR
Page 2 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
HMX	1/10	0.019	0.002 - 0.02	0.0057	0.0092	0.0092
Lead	1/8	0.0278	0.001 - 0.005	0.004	0.046	0.0278
Manganese	8/8	0.035 - 0.81	NA	0.225	1.53	0.81
Mercury	2/8	0.00023 - 0.00062	0.0001	0.00017	0.00035	0.00035
Methylene chloride	1/7	0.0022	0.005 - 0.036	0.004	0.011	0.0022
Nickel	1/8	0.0365	0.001 - 0.04	0.016	0.0239	0.0239
N-Nitrosodiphenylamine	3/7	0.0016 - 0.0022	0.01	0.004	0.007	0.0022
RDX	1/10	0.017	0.002 - 0.02	0.0065	0.0097	0.0097
Selenium	2/8	0.0025 - 0.0026	0.002 - 0.01	0.003	0.004	0.0026
Vanadium	1/8	0.0369	0.001 - 0.04	0.015	0.0237	0.0237
Zinc	6/8	0.019 - 0.112	0.005 - 0.01	0.04	0.0654	0.0654

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

Table 4-24

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (ALLUVIAL AQUIFER) - ORR

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
2,4,6-Trinitrotoluene	2/17	0.01375 - 0.1152	0.002 - 0.02	0.013	0.0285	0.0285
2,6-Dinitrotoluene	1/17	0.0029	0.002 - 0.02	0.0044	0.0053	0.0029
Aluminum	4/7	0.0778 - 0.5	0.085 - 0.2	0.23	1.1	0.5
Arsenic	3/7	0.0021 - 0.028	0.002 - 0.005	0.007	0.12	0.028
Barium	4/7	0.0241 - 0.1215	0.1	0.058	0.1033	0.1033
Benzo(a)anthracene	1/7	0.0012	0.01	0.005	0.0085	0.0012
Bis(2-ethylhexyl)phthalate	2/7	0.0037 - 0.0046	0.01	0.0048	0.0051	0.0046
Butylbenzylphthalate	3/7	0.001 - 0.0028	0.01	0.0036	0.0050	0.0028
Chromium	3/7	0.001 - 0.0149	0.002 - 0.03	0.011	0.138	0.0149
Chrysene	1/7	0.0014	0.01	0.005	0.008	0.0014
Cobalt	2/7	0.0017 - 0.0021	0.001 - 0.04	0.011	0.967	0.0021
Di-n-octylphthalate	1/7	0.0021	0.01	0.005	0.0063	0.0021
Lead	1/4	0.012	0.005 - 0.01	0.005	0.059	0.012
Manganese	7/7	0.024 - 0.575	NA	0.24	2.0	0.575
Nickel	1/7	0.0277	0.001 - 0.04	0.016	0.0233	0.0233

Table 4-24
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (ALLUVIAL AQUIFER) - ORR
Page 2 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
N-Nitrosodiphenylamine	1/7	0.0016	0.01	0.005	0.007	0.0016
RDX	1/17	0.0345	0.002 - 0.02	0.0099	0.022	0.022
Selenium	1/7	0.0023	0.002 - 0.01	0.003	0.0067	0.0023
Silver	3/7	0.001 - 0.0012	0.001 - 0.03	0.007	0.29	0.0012
Trichlorofluoromethane	2/4	0.0018 - 0.005	0.005	0.003	0.007	0.005
Vanadium	3/7	0.001 - 0.0021	0.001 - 0.04	0.01	0.68	0.0021
Zinc	3/7	0.02 - 0.07305	0.004 - 0.01	0.02	0.32	0.07305

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-25

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL - NAVY DETONATION AREA AT THE DR

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
2,4-Dinitrotoluene	1/3	0.035	0.25	0.097	24.2	0.035
2,4,6-Trinitrotoluene	1/3	0.456	0.25	0.230	62.9	0.456
Antimony	3/3	0.92 - 1.4	NA	1.2	2.3	1.4
Arsenic	3/3	9.0 - 11.8	NA	10.7	15.0	11.8
Barium	3/3	169 - 661	NA	379	33,790	661
Benzo(g,h,i)perylene	1/3	0.028	0.34 - 0.36	0.134	7,033	0.028
Beryllium	3/3	0.64 - 1.1	NA	0.81	1.9	1.1
Butylbenzylphthalate	1/3	0.023	0.35 - 0.36	0.137	81,639	0.023
Cadmium	2/3	1.2 - 2.6	0.21	1.5	7.5E+11	2.6
Chromium	3/3	14.5 - 17.4	NA	15.6	18.9	17.4
Chrysene	1/3	0.023	0.34 - 0.36	0.135	73,234	0.023
Copper	3/3	16.3 - 109	NA	68.4	8.2E+05	109
Di-n-butylphthalate	3/3	0.018 - 0.036	NA	0.024	0.103	0.036
Fluoranthene	1/3	0.045	0.34 - 0.36	0.135	49.2	0.045
Hexachlorobenzene	1/3	0.036	0.34 - 0.36	0.134	716	0.036

TABLE 4-25
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL - NAVY DETONATION AREA AT THE DR
Page 2 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
Lead	3/3	16.3 - 40.2	NA	28	233	40.2
Nickel	3/3	10.6 - 22.0	NA	17.7	80	22
Phenanthrene	1/3	0.044	0.34 - 0.36	0.135	54.3	0.044
Pyrene	1/3	0.043	0.34 - 0.36	0.135	127	0.043
RDX	1/3	0.732	1.0	0.575	1.1	0.732
Silver	1/3	0.58	0.21 - 0.22	0.252	2,415	0.58
Vanadium	3/3	17.0 - 22.8	NA	19.9	28.2	22.8
Zinc	3/3	36.0 - 86.0	NA	67.8	647	86.0

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable. NC = Not calculated due to insufficient data.

TABLE 4-26

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL - ARMY DETONATION AREA AT THE DR

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
2-Methylnaphthalene	6/8	0.023 - 0.083	0.35 - 0.37	0.072	0.21	0.083
2,4-Dimethylphenol	1/8	0.042	0.34 - 0.37	0.157	0.188	0.042
2,4-Dinitrotoluene	7/8	0.06 - 0.27	0.25	0.147	0.228	0.23
2,4,6-Trinitrotoluene	8/8	0.602 - 3.03	NA	1.72	2.27	2.27
4-Methylphenol	1/8	0.036	0.34 - 0.37	0.156	0.189	0.036
Acenaphthene	1/8	0.023	0.34 - 0.37	0.155	0.191	0.023
Anthracene	2/8	0.018 - 0.021	0.34 - 0.37	0.136	0.184	0.021
Antimony	6/8	0.72 - 0.88	0.62 - 0.68	0.668	0.814	0.814
Arsenic	8/8	5.1 - 17.5	NA	10.5	14.5	14.5
Benzo(a)anthracene	6/8	0.023 - 0.038	0.35 - 0.37	0.063	0.185	0.038
Benzo(a)pyrene	6/8	0.023 - 0.042	0.35 - 0.37	0.063	0.188	0.042
Benzo(b)fluoranthene	6/8	0.02 - 0.049	0.35 - 0.37	0.064	0.197	0.049
Benzo(g,h,i)perylene	7/8	0.02 - 0.07	0.37	0.056	0.115	0.07
Butylbenzylphthalate	2/8	0.02 - 0.026	0.34 - 0.35	0.135	0.181	0.026
Cadmium	8/8	1.1 - 3.8	NA	2.6	3.3	3.3

TABLE 4-26
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL - ARMY DETONATION AREA AT THE DR
Page 2 of 3

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
Carbazole	4/8	0.018 - 0.023	0.34 - 0.37	0.104	0.647	0.023
Chromium	8/8	4.7 - 14.7	NA	11.1	13.1	13.1
Chrysene	7/8	0.024 - 0.062	0.37	0.054	0.11	0.062
Copper	8/8	58.5 - 146	NA	107	131	131
Cyanide	8/8	0.18 - 1.2	NA	0.675	0.897	0.897
Diethylphthalate	7/8	0.018 - 0.20	0.37	0.069	0.216	0.20
Di-n-butylphthalate	8/8	0.028 - 0.27	NA	0.093	0.264	0.264
Di-n-octylphthalate	1/8	0.018	0.34 - 0.37	0.155	0.192	0.018
Fluoranthene	8/8	0.025 - 0.088	NA	0.06	0.075	0.075
Fluorene	3/8	0.018- 0.025	0.34 - 0.37	0.117	0.170	0.025
Hexachlorobenzene	4/8	0.02 - 0.046	0.34 - 0.37	0.107	0.488	0.046
Lead	8/8	19.8 - 53	NA	35.4	42.7	42.7
Naphthalene	8/8	0.03 - 0.11	NA	0.054	0.083	0.083
Nickel	8/8	8.4 - 27.1	NA	21.0	24.9	24.9
N-Nitrosodiphenylamine	4/8	0.039 - 0.33	0.34 - 0.37	0.154	0.215	0.215
Pentachlorophenol	3/8	0.019 - 0.024	0.82 - 0.89	0.271	0.411	0.024

TABLE 4-26
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL - ARMY DETONATION AREA AT THE DR
Page 3 of 3

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
Phenanthrene	8/8	0.024 - 0.19	NA	0.097	0.13	0.13
Pyrene	8/8	0.044 - 0.16	NA	0.102	0.126	0.126
RDX	8/8	1.78 - 4.76	NA	2.87	3.8	3.8
Silver	5/8	0.43 - 0.69	0.21 - 0.23	0.39	0.55	0.55
Vanadium	8/8	6.0 - 18.2	NA	13.1	15.6	15.6
Zinc	8/8	49.6 - 137	NA	98.8	120	120

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable. NC = Not calculated due to insufficient data.

TABLE 4-27

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - BOGGS CREEK SURFACE WATER (DR)

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
Aluminum	2/2	0.158 - 0.246	NA	0.202	0.48	0.246
Barium	2/2	0.0447 - 0.0539	NA	0.0493	0.078	0.0539
Cadmium	2/2	0.0027 - 0.0107	NA	0.0067	0.032	0.0107
Cobalt	2/2	0.0049 - 0.0288	NA	0.0169	0.0923	0.0288
Copper	2/2	0.0164 - 0.0441	NA	0.0303	0.118	0.0441
Lead	1/2	0.002	0.001	0.0013	0.006	0.002
Manganese	2/2	0.506 - 2.0	NA	1.25	5.97	2.0
Nickel	2/2	0.011 - 0.0396	NA	0.0253	0.116	0.0396
Trichloroethylene	1/2	0.001	0.01	0.003	0.0156	0.001
Zinc	2/2	0.0491 - 0.21	NA	0.13	0.64	0.21

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-28

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - BOGGS CREEK SEDIMENT (DR)

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
2-Butanone	1/2	0.018	0.013	0.0123	0.0486	0.018
Acetone	2/2	0.016 - 0.062	NA	0.039	0.184	0.062
Butylbenzylphthalate	1/2	0.026	0.42	0.118	0.70	0.026
Di-n-butylphthalate	2/2	0.024 - 0.029	NA	0.0265	0.0423	0.029
Toluene	1/2	0.014	0.013	0.0103	0.0339	0.014

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-29

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (BEECH CREEK AQUIFER) - DR

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
1,4-Dichlorobenzene	1/7	0.0008	0.01	0.005	0.01	0.0008
Acetone	1/7	0.012	0.01	0.006	0.008	0.008
Arsenic	1/7	0.01255	0.002 - 0.01	0.0034	0.016	0.01255
Barium	6/7	0.0423 - 0.14	0.01	0.091	0.117	0.117
Butylbenzylphthalate	3/7	0.001 - 0.0025	0.01	0.004	0.008	0.0025
Chromium	2/7	0.0022 - 0.0027	0.001 - 0.03	0.008	0.257	0.0027
Copper	1/7	0.00195	0.001 - 0.03	0.0078	0.71	0.00195
Diethylphthalate	1/7	0.0006	0.01	0.005	0.014	0.0006
Manganese	5/7	0.0633 - 0.367	0.001 - 0.01	0.23	947	0.367
Silver	1/7	0.001	0.001 - 0.03	0.007	0.75	0.001
Vanadium	1/7	0.00145	0.001 - 0.04	0.01	2.1	0.00145

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-30A

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (ALLUVIAL AQUIFER) - DR NAVY DETONATION AREA

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
Aluminum	2/2	0.841 - 81.8	NA	42.3	297	81.8
Arsenic	2/2	0.002 - 0.035	NA	0.019	0.123	0.035
Barium	2/2	0.0148 - 0.0433	NA	0.039	0.129	0.0433
Beryllium	1/2	0.0091	0.001	0.005	0.032	0.0091
Cadmium	1/2	0.0058	0.001	0.003	0.020	0.0058
Chromium	1/2	0.0193	0.004	0.011	0.065	0.0193
Cobalt	2/2	0.0079 - 0.265	NA	0.136	0.948	0.265
Copper	2/2	0.0037 - 0.0066	NA	0.005	0.014	0.0066
Lead	2/2	0.002 - 0.0025	NA	0.0022	0.0038	0.0025
Manganese	2/2	0.373 - 6.64	NA	3.5	23.3	6.64
Naphthalene	1/2	0.0006	0.01	0.0028	0.017	0.0006
Nickel	2/2	0.0147 - 1.06	NA	0.537	3.84	1.06
RDX	1/4	0.036	0.014 - 0.02	0.0152	0.154	0.036
Vanadium	2/2	0.0021 - 0.0163	NA	0.0092	0.054	0.0163
Zinc	2/2	0.0188 - 1.82	NA	0.92	6.6	1.82

TABLE 4-30A (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (ALLUVIAL AQUIFER) - DR NAVY DETONATION AREA
Page 2 of 2

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-30B

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (ALLUVIAL AQUIFER) - DR ARMY DETONATION AREA
Page 1 of 2

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/L)	Range of Reporting Limits (mg/L)	Arithmetic Mean Concentration (mg/L)	95% UCL Concentration (mg/L)	Exposure Point Concentration[B] (mg/L)
2,4,6-Trichlorophenol	1/3	0.001	0.01	0.004	23.8	0.001
Aluminum	3/3	1.87 - 7.07	NA	4.2	329	7.07
Arsenic	3/3	0.0036 - 0.0057	NA	0.005	0.009	0.0057
Barium	3/3	0.0337 - 0.0956	NA	0.057	1.2	0.0956
Bis(2-ethylhexyl)phthalate	2/3	0.01 - 0.016	0.010	0.01	0.29	0.016
Butylbenzylphthalate	1/3	0.005	0.01	0.005	0.005	0.005
Chromium	3/3	0.0086 - 0.0271	NA	0.018	0.48	0.0271
Cobalt	3/3	0.0016 - 0.0032	NA	0.0022	0.0086	0.0032
Copper	2/3	0.006 - 0.0104	0.004	0.006	8.5	0.0104
Lead	2/3	0.0033 - 0.015	0.005	0.007	58	0.015
Manganese	3/3	0.0903 - 0.5945	NA	0.253	9,669	0.5945
Nickel	3/3	0.0088 - 0.0298	NA	0.0156	1.5	0.0298
Vanadium	3/3	0.0017 - 0.0093	NA	0.005	7.3	0.0093
Zinc	3/3	0.02385 - 0.03195	NA	0.029	0.04	0.03195

TABLE 4-30B (Continued)
EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (ALLUVIAL AQUIFER) - DR ARMY DETONATION AREA
Page 2 of 2

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-31

EXPOSURE POINT CONCENTRATIONS OF CHEMICALS OF POTENTIAL CONCERN - VENISON

Chemical	Frequency of Detection[A]	Range of Detected Values (mg/kg)	Range of Reporting Limits (mg/kg)	Arithmetic Mean Concentration (mg/kg)	95% UCL Concentration (mg/kg)	Exposure Point Concentration[B] (mg/kg)
2-Butanone (MEK)	1/1	0.011	NA	NA	NA	0.011
4-Methylphenol	1/1	0.049	NA	NA	NA	0.049
Acetone	1/1	0.28	NA	NA	NA	0.28
Aluminum	1/1	3.5	NA	NA	NA	3.5
Barium	1/1	0.29	NA	NA	NA	0.29
Carbon disulfide	1/1	0.035	NA	NA	NA	0.035
Copper	1/1	1.6	NA	NA	NA	1.6
Di-n-butylphthalate	1/1	0.019	NA	NA	NA	0.019
Manganese	1/1	0.4	NA	NA	NA	0.4
Selenium	1/1	0.26	NA	NA	NA	0.26
Zinc	1/1	35.8	NA	NA	NA	35.8

[A] Number of samples in which the analyte was detected/total number of samples analyzed.
[B] The 95% UCL (upper confidence limit of the mean) or the maximum detected value, whichever is lower (U.S. EPA, 1989).
NA = Not applicable.

TABLE 4-32

MAXIMUM DETECTION LIMITS ABOVE USEPA REGION 5 DQLS OR METHOD REPORTING LIMITS
WATER SAMPLES
Page 1 of 3

Analyte	Units	MRL	DQL		Enseco 1993 Ground Water	WES 1992 Ground Water	REI 1995 Ground Water	REI 1997 Ground Water	Enseco 1993 Spring Water	WES 1992 Surface Water	1995 Surface/ Spring Water	REI 1997 Surface Water
DQLS Less Than Method Reporting Limits:												
Antimony	ug/l	30	15	nca	200	-	-	-	-	-	-	-
Arsenic, total	ug/l	10	0.038	ca	-	na	-	-	-	na	3	-
Beryllium, total	ug/l	2	0.016	ca	2	na	1	1	2	na	1	1
Lead, total	ug/l	10	4	nca	5	na	-	5	5	na	-	-
Thallium, total	ug/l	10	2.9	nca	25	na	5.7	-	-	na	4	-
Cyanide	ug/l	40	6.2	nca	10	na	-	-	10	na	-	10
Aldrin	ug/l	0.34	0.004	ca	0.05	na	na	0.01	-	na	na	0.01
alpha-BHC	ug/l	0.35	0.011	ca	0.05	na	na	-	0.05	na	na	-
beta-BHC	ug/l	0.23	0.037	ca	0.05	na	na	-	0.05	na	na	-
gamma-BHC	ug/l	0.25	0.052	ca	0.05	na	na	-	0.05	na	na	-
Dieldrin	ug/l	0.02	0.0042	ca	0.1	na	na	0.02	0.1	na	na	0.02
Heptachlor	ug/l	0.4	0.015	ca	0.05	na	na	-	0.05	na	na	-
Heptachlor epoxide	ug/l	0.32	0.0074	ca	0.05	na	na	-	0.05	na	na	0.01
Toxaphene	ug/l	0.86	0.061	ca	5	na	na	1	5	na	na	1
2-Nitroaniline	ug/l	10	2.2	nca	100	na	25	20	50	na	25	20
3,3'-Dichlorobenzidine	ug/l	20	0.15	ca	40	na	10	5	20	na	10	5
Benzo(a)anthracene	ug/l	0.13	0.092	ca	20	na	10	5	10	na	10	5
Benzo(a)pyrene	ug/l	0.23	0.0092	ca	20	na	10	5	10	na	10	5
bis(2-Chloroethyl)ether	ug/l	10	0.0098	ca	20	na	10	5	10	na	10	5
Dibenzo(a,h)anthracene	ug/l	0.3	0.0092	ca	20	na	10	5	10	na	10	5
Hexachlorobenzene	ug/l	0.056	0.042	ca	20	na	10	5	10	na	10	5
Indeno(1,2,3-cd)pyrene	ug/l	0.43	0.092	ca	20	na	10	5	10	na	10	5
N-Nitroso-di-n-propylamine	ug/l	4.6	0.0096	ca	20	na	10	5	10	na	10	5
1,1,2,2-Tetrachloroethane	ug/l	1	0.055	ca	5	na	10	1	5	na	10	1
1,1,2-Trichloroethane	ug/l	1	0.2	ca	120	na	10	1	5	na	10	1
1,1-Dichloroethene	ug/l	0.07	0.046	ca	120	na	10	1	5	na	10	1
1,2-Dibromo-3-chloropropane	ug/l	1	0.048	ca	250	na	-	1	10	na	-	1
1,2-Dibromoethane	ug/l	1	0.0008	ca	250	na	-	1	10	na	-	1
1,2-Dichloroethane	ug/l	1	0.12	ca	5	na	200	1	5	na	10	1
Bromodichloromethane	ug/l	0.2	0.18	ca	120	na	200	1	5	na	10	1
Carbon Tetrachloride	ug/l	1	0.17	ca	120	na	200	1	5	na	10	1
Chlorobenzene	ug/l	0.03	39	nca	120	na	200		-	na	-	-
Chloroform	ug/l	0.2	0.16	ca	120	na	10	2	5	na	10	1
cis-1,3-Dichloropropene	ug/l	1	0.081	ca	120	na	200	1	5	na	10	1
trans-1,3-Dichloropropene	ug/l	1	0.081	ca	120	na	200	1	5	na	10	1
Vinyl Chloride	ug/l	0.2	0.02	ca	10	na	10	1	10	na	10	1
Aramite	ug/l	10	2.7	ca	20	na	na	na	10	na	na	na
1,4-Dioxane	ug/l	12	1	ca	12000	na	na	na	500	na	na	na
Kepone	ug/l	20	0.0037	ca	1	na	na	na	1	na	na	na
3,3'-Dimethylbenzidine	ug/l	10	0.0073	ca	20	na	na	na	10	na	na	na
Methacrylonitrile	ug/l	5	1	nca	120	na	na	na	5	na	na	na
N-Nitroso-di-n-butylamine	ug/l	10	0.012	ca	20	na	na	na	10	na	na	na
N-Nitrosodiethylamine	ug/l	20	0.0005	ca	20	na	na	na	10	na	na	na
N-Nitrosodimethylamine	ug/l	1.5	0.0013	ca	20	na	na	na	10	na	na	na
N-Nitrosomethylethylamine	ug/l	10	0.0031	ca	20	na	na	na	10	na	na	na
N-Nitrosopyrrolidine	ug/l	40	0.032	ca	20	na	na	na	10	na	na	na
Pentachloronitrobenzene	ug/l	20	0.26	ca	100	na	na	na	50	na	na	na
trans-1,4-Dichloro-2-butene	ug/l	1	0.0012	ca	120	na	na	na	5	na	na	na
1,1,1,2-Tetrachloroethane	ug/l	1	0.43	ca	120	na	na	na	5	na	na	na
Acrylonitrile	ug/l	5	3.7	ca	2500	na	na	na	100	na	na	na

Analyte	Units	MRL	DQL		Enseco 1993 Ground Water	WES 1992 Ground Water	REI 1995 Ground Water	REI 1997 Ground Water	Enseco 1993 Spring Water	WES 1992 Surface Water	1995 Surface/ Spring Water	REI 1997 Surface Water
Maximum Detection Limits Above Region 5 Data Quality Levels:												
DQLS Greater Than Method Reporting Limits:												
1,3,5-Trinitrobenzene	ug/l	0.26	1.8	nca	10	20	7.3	-	-	20	7.3	-
1,3-Dinitrobenzene	ug/l	0.11	3.7	nca	20	-	4	-	10	20	4	-
Nitrobenzene	ug/l	6.4	18	nca	-	27	-	-	-	-	-	-
PCBs	ug/l	5.4-9	0.0087	ca	1	na	na	0.4	1	na	na	0.4
1,4-Dichlorobenzene	ug/l	0.07	0.47	ca	10	na	10	1	10	na	10	1
2,4,6-Trichlorophenol	ug/l	5	6.1	ca	20	na	10	-	10	na	10	-
2,4-Dinitrophenol	ug/l	50	73	nca	100	na	-	-	-	na	-	-
Benzo(b)fluoranthene	ug/l	0.17	0.92	ca	20	na	10	5	10	na	10	5
Benzo(k)fluoranthene	ug/l	0.17	0.92	ca	20	na	10	5	10	na	10	5
bis(2-Ethylhexyl)phthalate	ug/l	2.7	4.8	ca	10	na	10	-	-	na	10	5
Chrysene	ug/l	1.5	9.2	ca	20	na	10	-	10	na	10	-
Hexachlorobutadiene	ug/l	0.014	0.86	ca	20	na	10	5	10	na	10	5
Hexachloroethane	ug/l	0.016	4.8	ca	20	na	10	5	10	na	10	5
Pentachlorophenol	ug/l	0.076	0.56	ca	100	na	25	20	50	na	25	20
1,2-Dichloropropane	ug/l	0.06	0.16	ca	120	na	200	1	5	na	10	1
Benzene	ug/l	0.09	0.39	ca	120	na	200	1	5	na	10	1
Bromoform	ug/l	2	8.5	ca	120	na	200	-	-	na	10	-
Bromomethane	ug/l	1	8.7	nca	250	na	200	-	10	na	10	-
Chloromethane	ug/l	1	1.5	ca	250	na	200	-	10	na	10	-
Dibromochloromethane	ug/l	0.3	1	ca	120	na	200	-	5	na	10	-
Methylene chloride	ug/l	1	4.3	ca	5	na	32	-	-	na	25	-
Tetrachloroethene	ug/l	0.4	1.1	ca	5	na	10	-	5	na	10	-
Trichloroethene	ug/l	0.1	1.6	ca	5	na	10	-	-	na	10	-
Disulfoton	ug/l	0.7	1.5	nca	100	na	na	na	50	na	na	na
Methyl parathion	ug/l	0.5	9.1	nca	100	na	na	na	50	na	na	na
Phorate	ug/l	0.4	7.3	ca	200	na	na	na	100	na	na	na
Sulfotepp	ug/l	0.7	18	nca	100	na	na	na	50	na	na	na
Aniline	ug/l	10	11	nca	20	na	na	na	-	na	na	na
Pyridine	ug/l	5	37	nca	40	na	na	na	-	na	na	na
1,2,3-Trichloropropane	ug/l	1	31	ca	120	na	na	na	-	na	na	na
Acetonitrile	ug/l	10	220	nca	5000	na	na	na	-	na	na	na
Acrolein	ug/l	11	730	nca	2500	na	na	na	-	na	na	na
Dichlorodifluoromethane	ug/l	1	390	nca	500	na	na	na	-	na	na	na

Analyte	Units	MRL	DQL	Enseco 1993 Ground Water	WES 1992 Ground Water	REI 1995 Ground Water	REI 1997 Ground Water	Enseco 1993 Spring Water	WES 1992 Surface Water	1995 Surface/ Spring Water	REI 1997 Surface Water
Maximum Detection Limits Above Region 5 Method Reporting Limits:											
Cobalt	ug/l	10	NA	40	na	-	-	-	na	-	-
1,3-Dichlorobenzene	ug/l	0.2	NA	20	na	10	1	10	na	10	1
2-Methyl-4,6-dinitrophenol	ug/l	50	NA	100	na	-	-	-	na	-	-
2-Methylnaphthalene	ug/l	10	NA	20	na	-	-	-	na	-	-
2-Nitrophenol	ug/l	5	NA	20	na	10	-	10	na	10	-
4-Bromophenyl phenyl ether	ug/l	10	NA	20	na	-	-	-	na	-	-
4-Chloro-3-methylphenol	ug/l	5	NA	20	na	10	-	10	na	10	-
4-Chlorophenyl phenyl ether	ug/l	10	NA	20	na	-	-	-	na	-	-
3-Nitroaniline	ug/l	33	NA	100	na	-	-	50	na	-	-
4-Nitroaniline	ug/l	20	NA	100	na	25	-	50	na	25	-
4-Nitrophenol	ug/l	10	NA	100	na	25	20	50	na	25	20
Acenaphthylene	ug/l	10	NA	20	na	-	-	-	na	-	-
Benzo(g,h,i)perylene	ug/l	0.76	NA	20	na	10	-	10	na	10	5
bis(2-Chloroethoxy)methane	ug/l	10	NA	20	na	-	-	-	na	-	-
Phenanthrene	ug/l	10	NA	20	na	-	-	-	na	-	-
2-Hexanone	ug/l	50	NA	250	na	200	-	-	na	-	-
Isodrin	ug/l	20	NA	100	na	-	-	100	na	-	-
Methyl methanesulfonate	ug/l	10	NA	20	na	-	-	-	na	-	-
1,4-Naphthoquinone	ug/l	10	NA	20	na	na	na	-	na	na	na
1-Naphthylamine	ug/l	10	NA	20	na	na	na	-	na	na	na
2,6-Dichlorophenol	ug/l	10	NA	20	na	na	na	-	na	na	na
2-Acetylaminofluorene	ug/l	20	NA	200	na	na	na	100	na	na	na
2-Naphthylamine	ug/l	10	NA	20	na	na	na	-	na	na	na
2-Picoline	ug/l	5	NA	20	na	na	na	10	na	na	na
5-Nitro-o-toluidine	ug/l	10	NA	20	na	na	na	-	na	na	na
7,12-Dimethylbenz(a)anthracene	ug/l	10	NA	20	na	na	na	-	na	na	na
Chloroprene	ug/l	5	NA	120	na	na	na	-	na	na	na
p-Dimethylaminoazobenzene	ug/l	10	NA	20	na	na	na	-	na	na	na
a,a-Dimethylphenethylamine	ug/l	10	NA	20	na	na	na	-	na	na	na
Isosafrole	ug/l	10	NA	40	na	na	na	20	na	na	na
Pentachloroethane	ug/l	5	NA	20	na	na	na	10	na	na	na
Propionitrile	ug/l	5	NA	120	na	na	na	-	na	na	na
Safrole	ug/l	10	NA	20	na	na	na	-	na	na	na
o-Toluidine	ug/l	10	NA	20	na	na	na	-	na	na	na
o,o,o-Triethylphosphorothioate	ug/l	10	NA	20	na	na	na	-	na	na	na

Notes:

- - Exceedance of DQL not observed or comparison was unnecessary (either not analyzed or compound was detected).
na - Not analyzed.
ca - Known carcinogen
nca - Non-carcinogen
MRL - Method Reporting Limit
DQL - Data Quality Level

TABLE 4-33

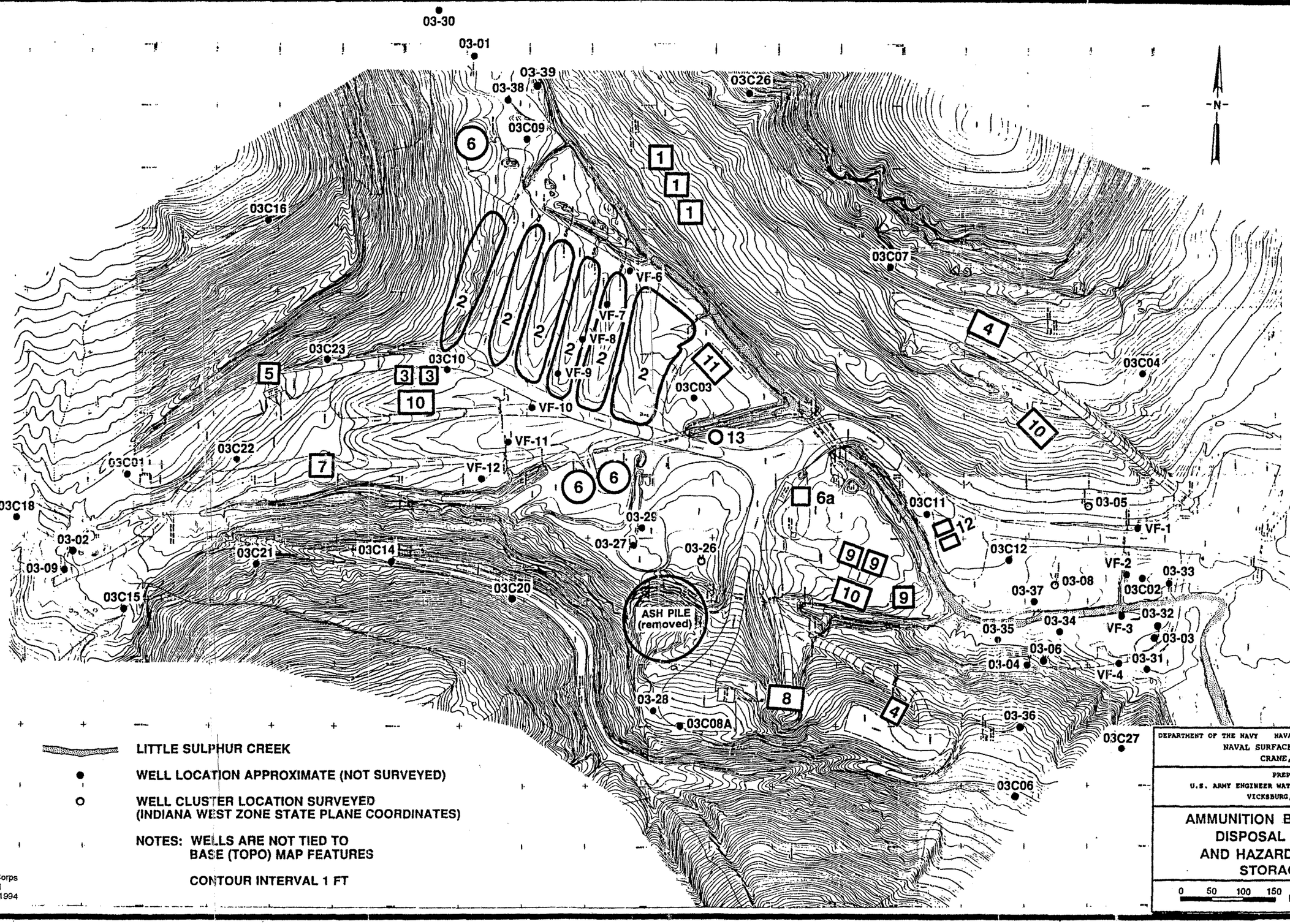
MAXIMUM DETECTION LIMITS ABOVE USEPA REGION 5 DQLS OR METHOD REPORTING LIMITS

Analyte	Units	MRL	DQL		Surface Soil Jeep Trail	Subsurface Soil ABG	Surface Soil ABG	Soil ORR	Soil DR	Sediment ABG
Maximum Detection Limits Above Region 5 Data Quality Levels:										
PCB-1221	ug/kg	36.2-603	66		-	72	84	85	-	-
1,4-Dichlorobenzene	ug/kg	0.07	7,400	ca	9600	-	-	-	-	-
2-Nitroaniline	ug/kg	670	3900	ca	23000	-	-	-	-	-
3,3'-Dichlorobenzidine	ug/kg	1300	9900	ca	9600	-	-	-	-	-
Benzo(a)anthracene	ug/kg	8.7	610	ca	9600	-	-	-	-	-
Benzo(a)pyrene	ug/kg	15.4	61	ca	9600	350	410	-	410	410
Benzo(b)fluoranthene	ug/kg	12.1	610	ca	9600	-	-	-	-	-
Benzo(k)Fluoranthene	ug/kg	11.4	6100	ca	9600	-	-	-	-	-
bis(2-Chloroethyl)ether	ug/kg	660	74	ca	9600	350	410	750	410	410
Dibenzo(a,h)anthracene	ug/kg	20.1	61	ca	9600	350	410	-	410	410
Hexachlorobenzene	ug/kg	3.8	280	ca	9600	350	410	750	410	410
Hexachlorobutadiene	ug/kg	0.9	5700	ca	9600	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	ug/kg	29	610	ca	9600	-	-	-	-	-
N-Nitroso-di-n-propylamine	ug/kg	660	63	ca	9600	350	410	750	410	410
Pentachlorophenol	ug/kg	400	2500	ca	23000	-	-	-	-	-
Vinyl Chloride	ug/kg	0.2	5.2	ca	-	11	13	13	-	12
Maximum Detection Limits Above Region 5 Method Reporting Limits:										
2-Methyl-4,6-dinitrophenol	ug/kg	3300	NA		23000	-	-	-	-	-
2-Methylnaphthalene	ug/kg	660	NA		9600	-	-	750	-	-
2-Nitrophenol	ug/kg	300	NA		9600	350	410	750	410	410
3-Nitroaniline	ug/kg	2211	NA		23000	-	-	-	-	-
4-Bromophenyl phenyl ether	ug/kg	660	NA		9600	-	-	750	-	-
4-Chloro-3-methylphenol	ug/kg	240	NA		9600	350	410	750	410	410
4-Chlorophenyl phenyl ether	ug/kg	660	NA		9600	-	-	750	-	-
4-Nitroaniline	ug/kg	7370	NA		23000	-	-	-	-	-
4-Nitrophenol	ug/kg	470	NA		23000	890	1000	1100	890	1000
Acenaphthylene	ug/kg	660	NA		9600	-	-	750	-	-
Benzo(g,h,i)perylene	ug/kg	51	NA		9600	350	410	-	410	410
Bis(2-chloroethoxy)methane	ug/kg	660	NA		9600	-	-	750	-	-
Phenanthrene	ug/kg	660	NA		9600	-	-	-	-	-

- - Exceedance of DQL not observed or comparison was unnecessary (either not analyzed or compound was detected).
ca - Known carcinogen
MRL - Method Reporting Limit
DQL - Data Quality Level

APPENDIX 5-1

PLATE FIGURES



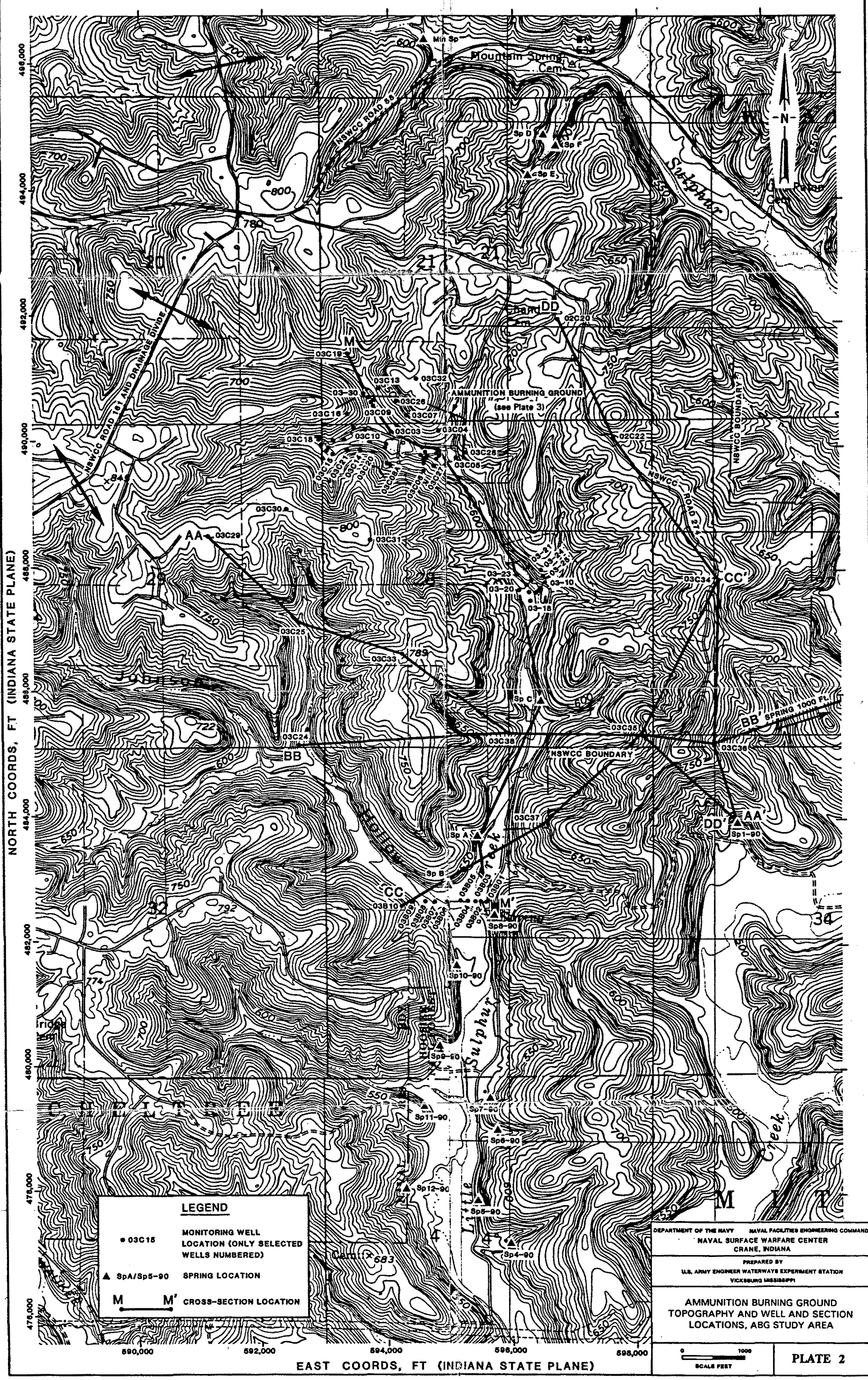
Reference: US Army Corps of Engineers, Technical Report GL-94-15, May 1994 Volume II

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA

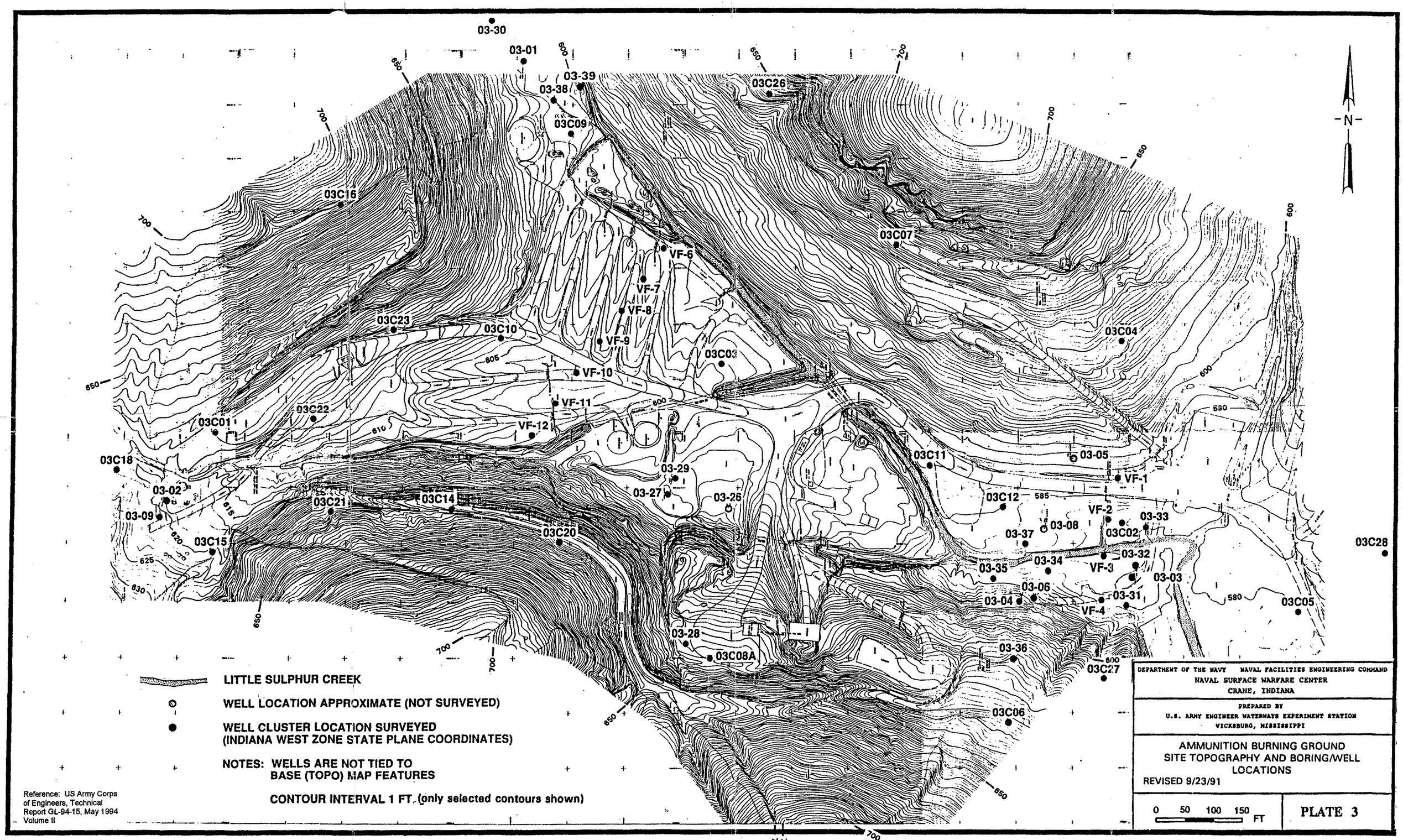
PREPARED BY
U.S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION
VICKSBURG, MISSISSIPPI

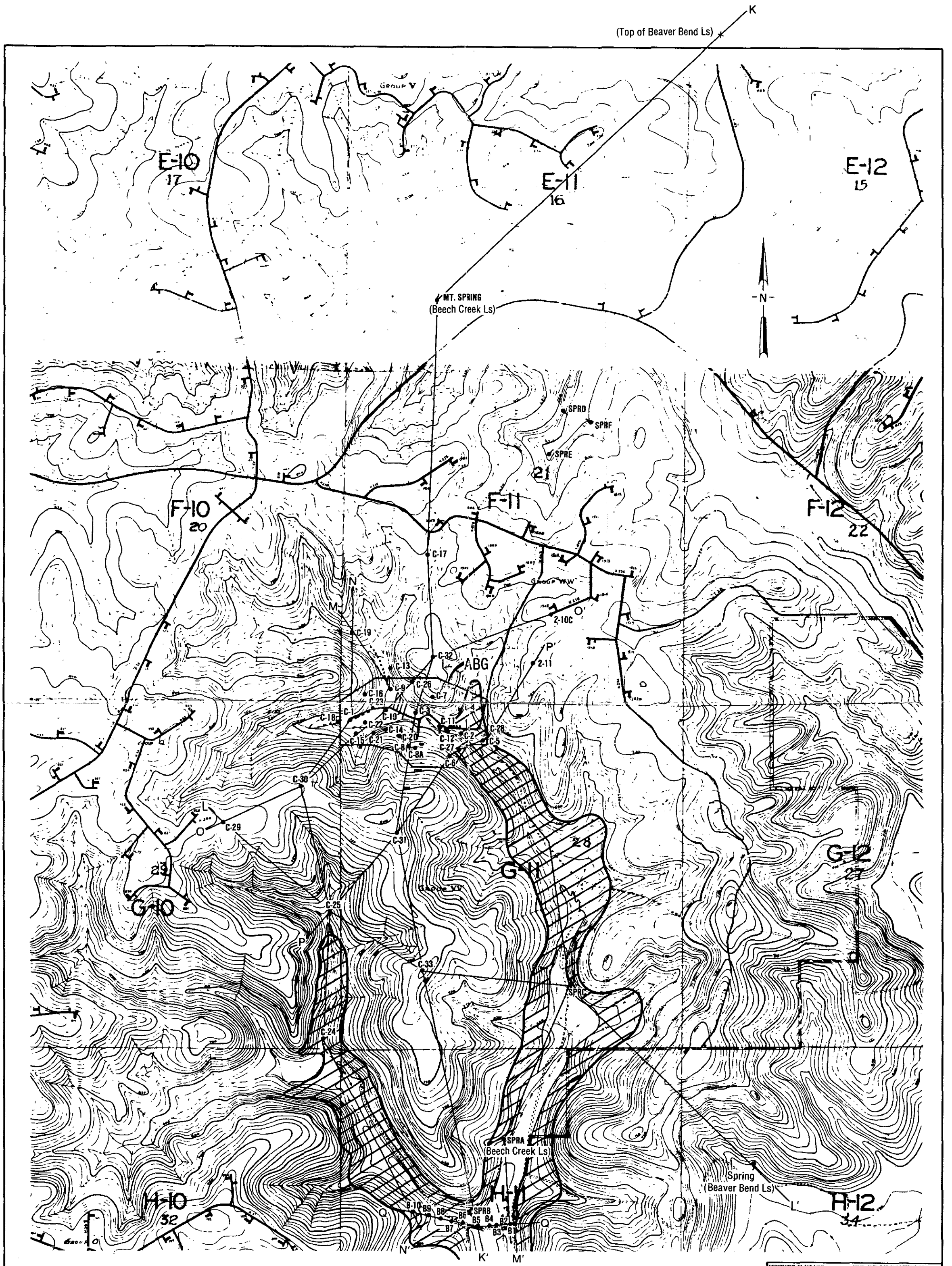
AMMUNITION BURNING GROUND
DISPOSAL OPERATIONS
AND HAZARDOUS MATERIAL
STORAGE AREAS

PLATE 1



Reference: US Army Corps of Engineers, Technical Report GL-94-15, May 1994 Volume II


03-30
03-01
03-39
03-38
03C09
03C26
03C16
03C07
VF-6
VF-7
VF-8
VF-9
VF-10
VF-11
VF-12
03C23
03C10
03C03
03C04
03C22
03C01
03C18
03-02
03-09
03C21
03C14
03C20
03C15
03-29
03-27
03-26
03C11
03-05
VF-1
03C12
VF-2
03-33
03-08
03-37
03C02
03-32
03-34
03-35
VF-3
03-03
03-06
03-04
03-31
VF-4
03C28
03C05
03-28
03C08A
03-36
03C27
03C06
N
LITTLE SULPHUR CREEK
WELL LOCATION APPROXIMATE (NOT SURVEYED)
WELL CLUSTER LOCATION SURVEYED
(INDIANA WEST ZONE STATE PLANE COORDINATES)
NOTES: WELLS ARE NOT TIED TO
BASE (TOPO) MAP FEATURES
CONTOUR INTERVAL 1 FT. (only selected contours shown)
Reference: US Army Corps
of Engineers, Technical
Report GL-94-15, May 1994
Volume II
DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
NAVAL SURFACE WARFARE CENTER
CRANE, INDIANA
PREPARED BY
U.S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION
VICKSBURG, MISSISSIPPI
AMMUNITION BURNING GROUND
SITE TOPOGRAPHY AND BORING/WELL
LOCATIONS
REVISED 9/23/91
0 50 100 150 FT
PLATE 3



Reference: US Army Corps of Engineers, Technical Report GL-88-27, October

APPROXIMATE AREA OF SOLUTIONING IN BEECH CREEK LIMESTONE

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

NAVAL WEAPONS SUPPORT CENTER

CRANE, INDIANA

PREPARED BY
U.S. ARMY ENGINEER WATERWAYS EXPERIMENT STATION
VICKSBURG, MISSISSIPPI

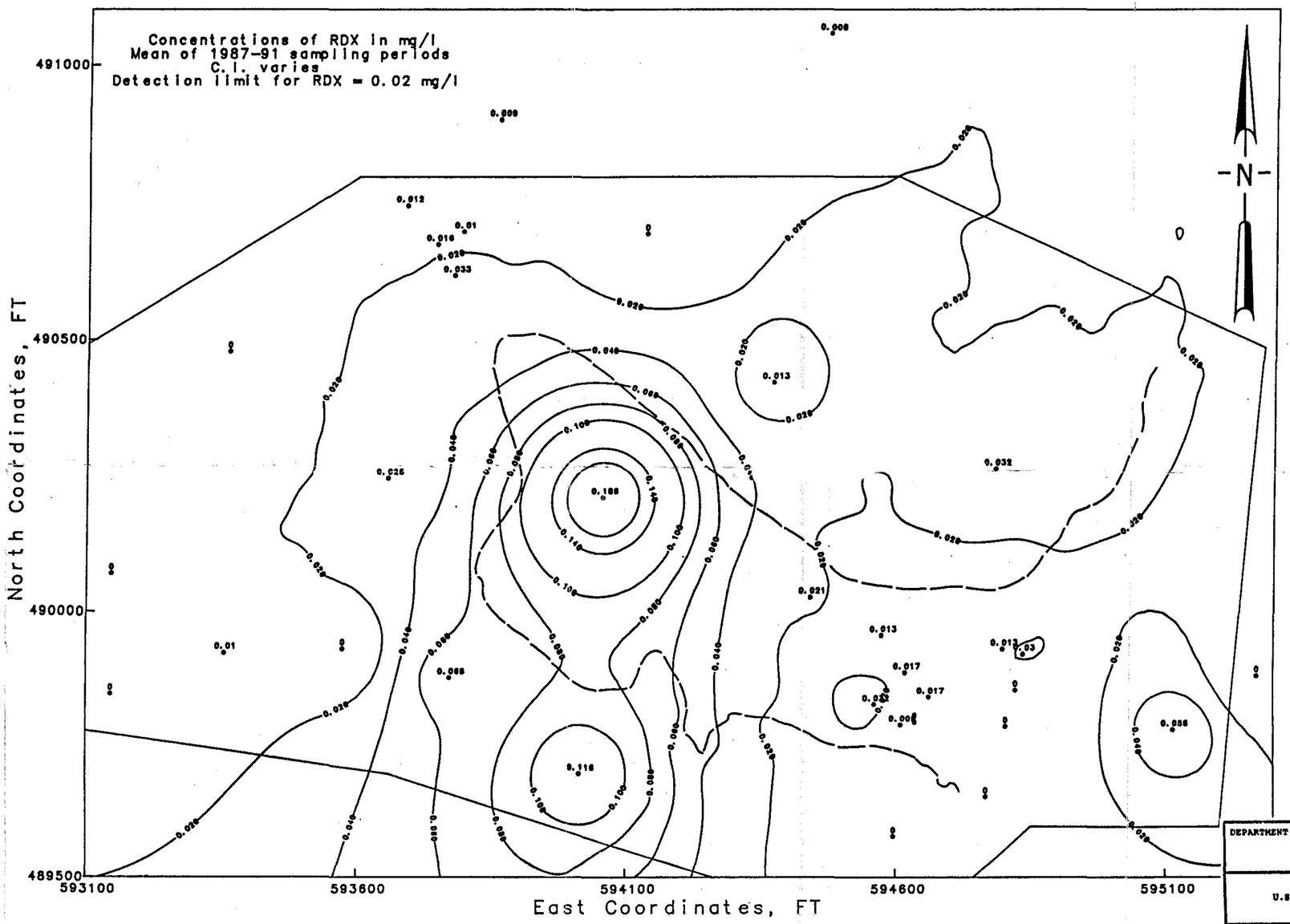
DRAWN BY R. Hunt
CHECKED BY W. Murphy

PLAN, BORING AND CROSS SECTION LOCATIONS
ABG Study Area

500 0 500 FT

PLATE 13

RDX Concentration, Beech Creek Wells, Ammunition Burning Ground



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VICKSBURG, MISSISSIPPI

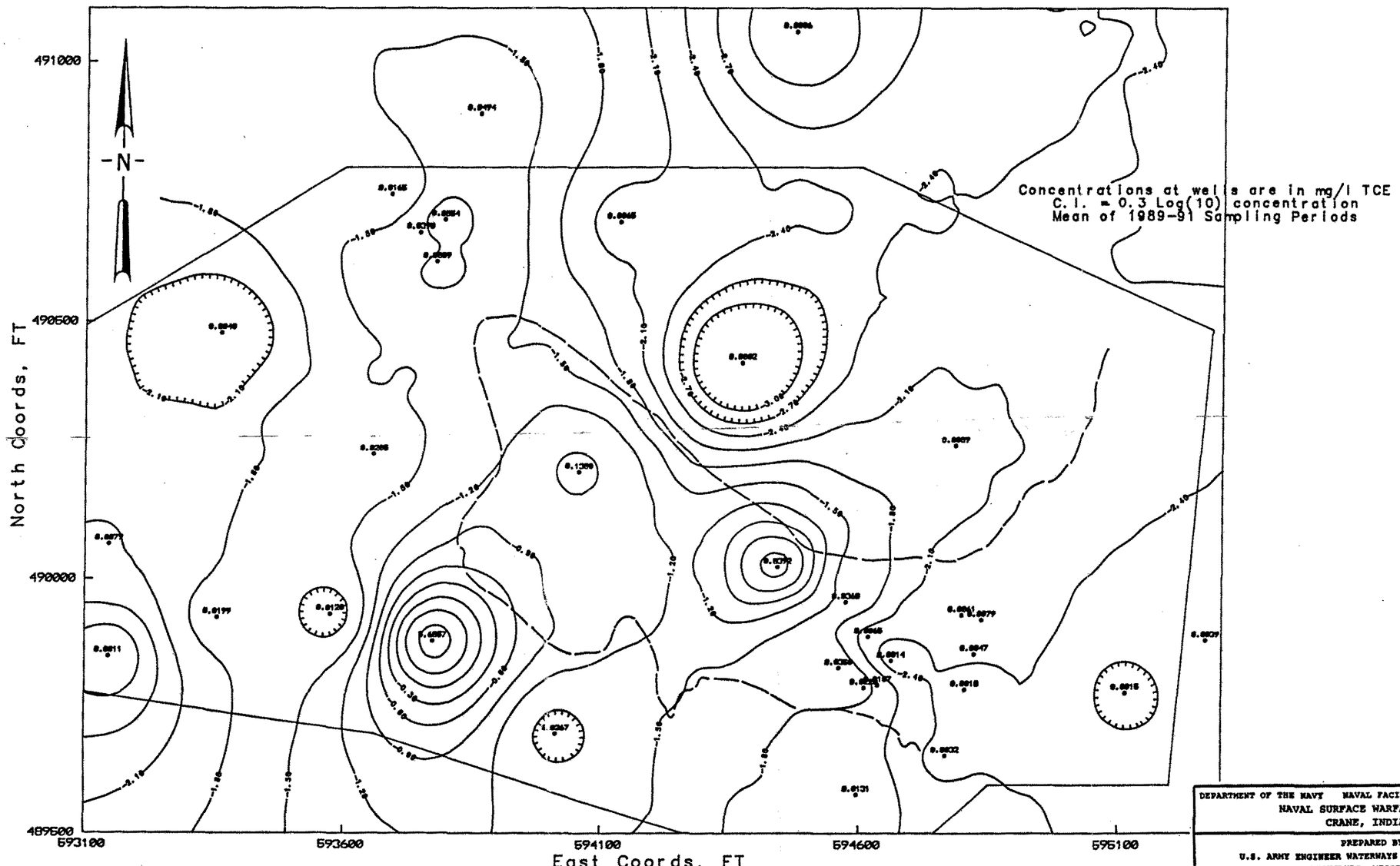
AMMUNITION BURNING GROUND
RDX Concentration in Beech Creek Aquifer

0 100 200 FT

PLATE 14

Reference: US Army Corps of Engineers, Technical Report GL-94-15, May 1994 Volume II

TCE Concentration, Beech Creek Wells, Ammunition Burning Ground



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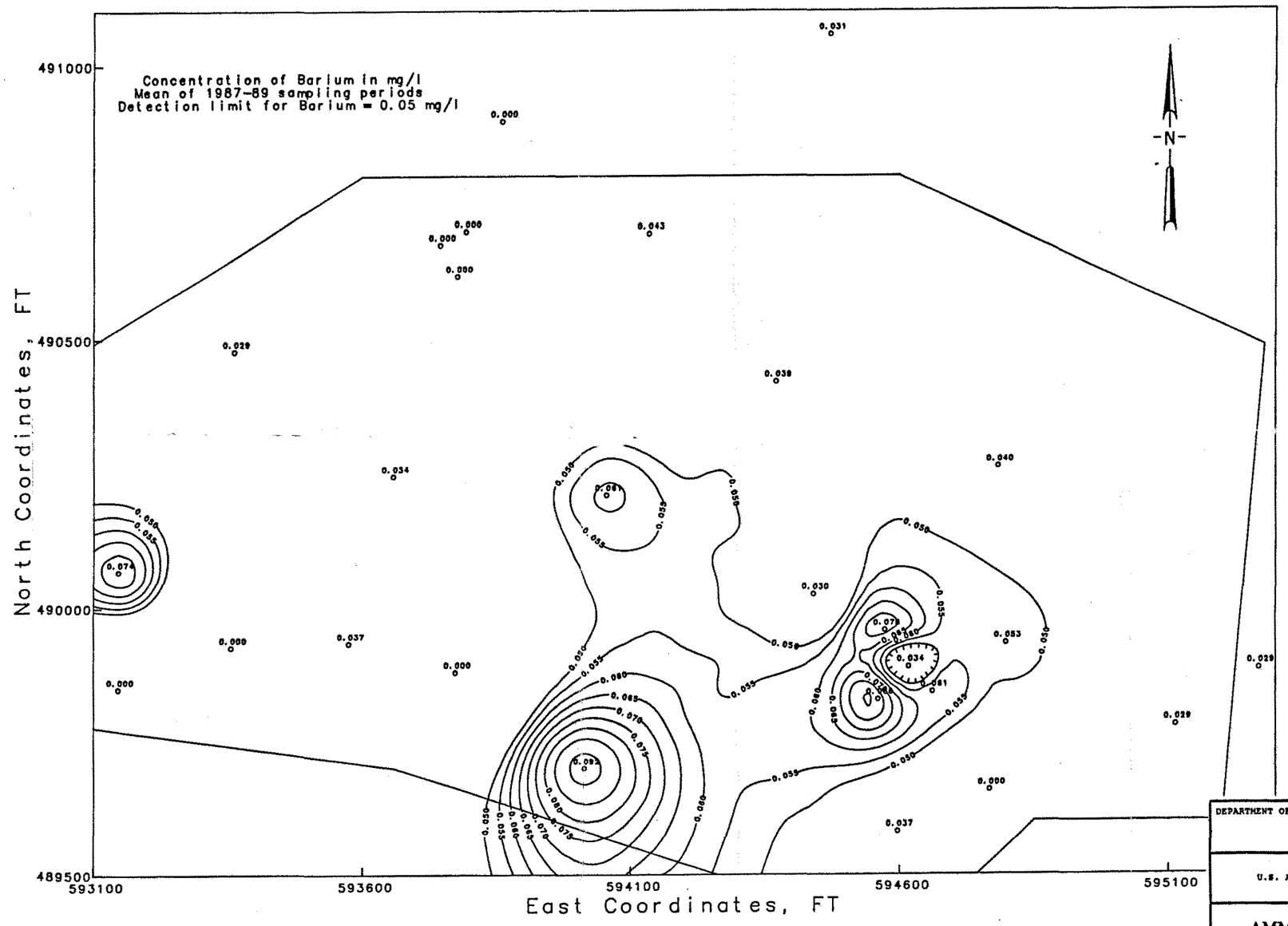
AMMUNITION BURNING GROUND
TCE Concentration in
Beech Creek Aquifer

0 100 200 FT

PLATE 15

Reference: US Army Corps of Engineers, Technical Report GL-94-15, May 1994 Volume II

Barium Concentration, Beech Creek Wells, Ammunition Burning Ground



Reference: US Army Corps of Engineers, Technical Report GL-94-15, May 1994 Volume II

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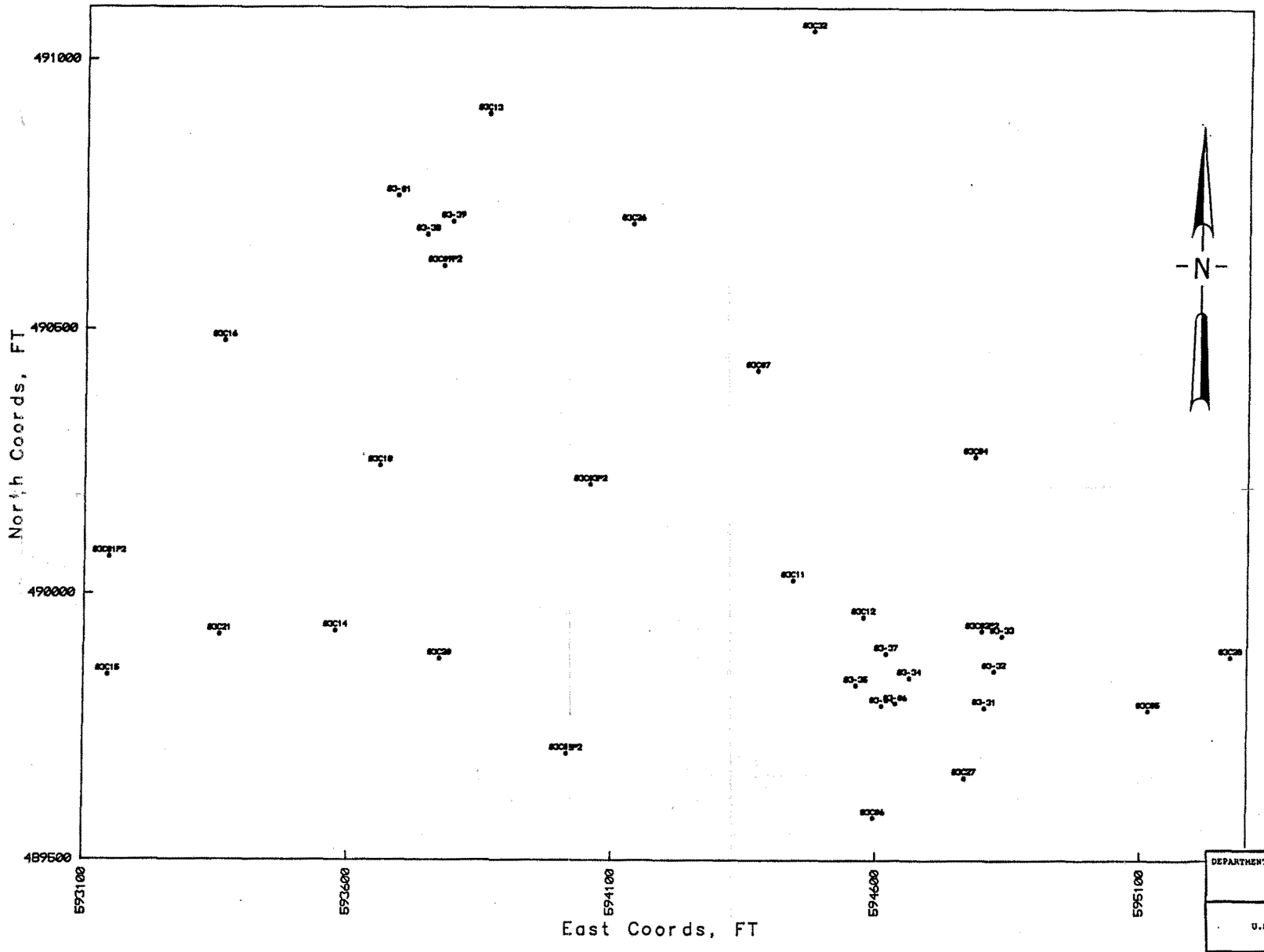
AMMUNITION BURNING GROUND
Barium Concentration in
Beech Creek Aquifer

0 100 200 FT

PLATE 16

Beech Creek Wells, Ammunition Burning Ground, Sept 1991



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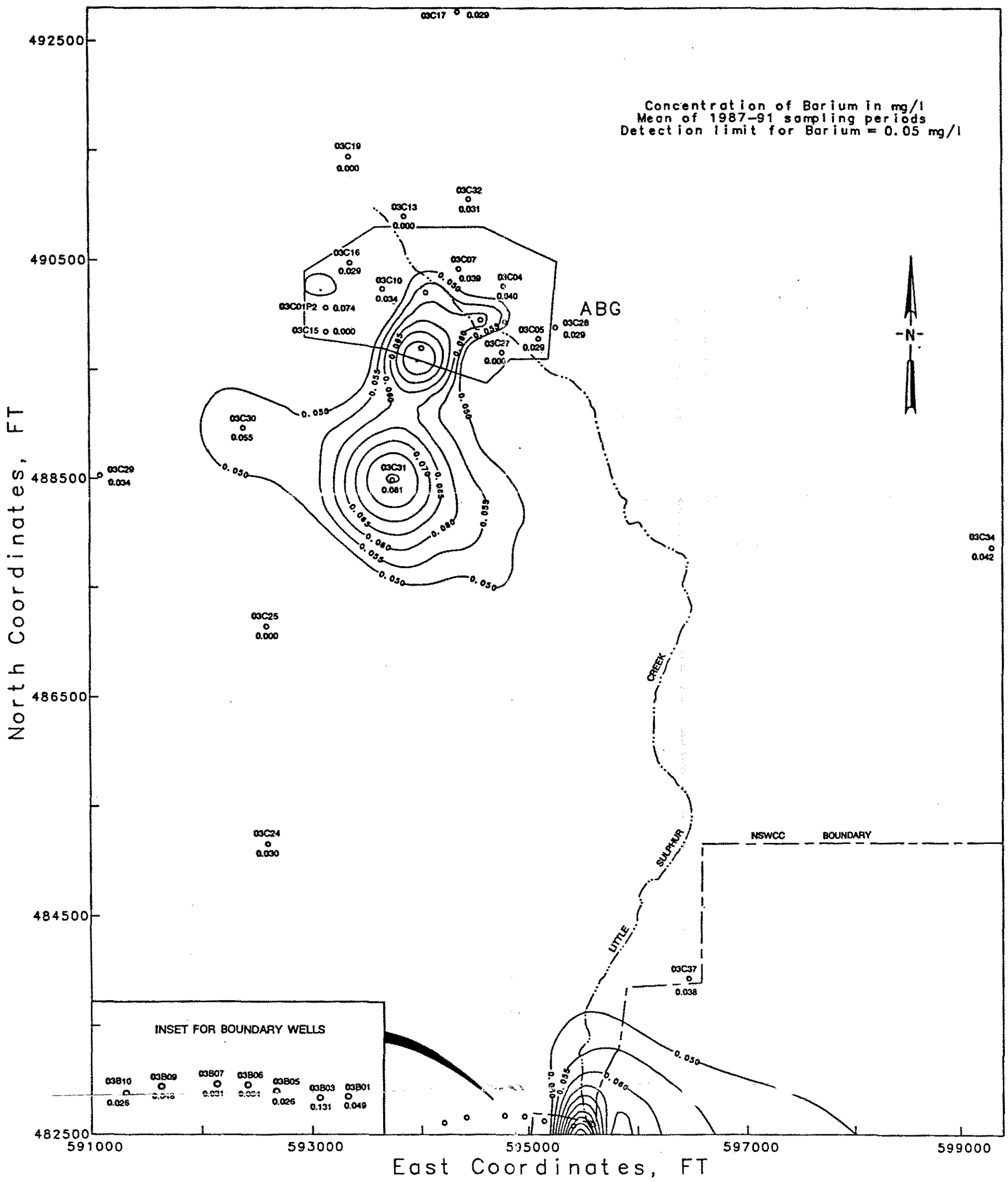
AMMUNITION BURNING GROUND
Reference Map for
Plates 14, 15 and 16

0 100 200 FT

PLATE 17

Reference: US Army Corps of Engineers, Technical Report GL-94-15, May 1994 Volume II

Barium Concentration, ABG Study Area



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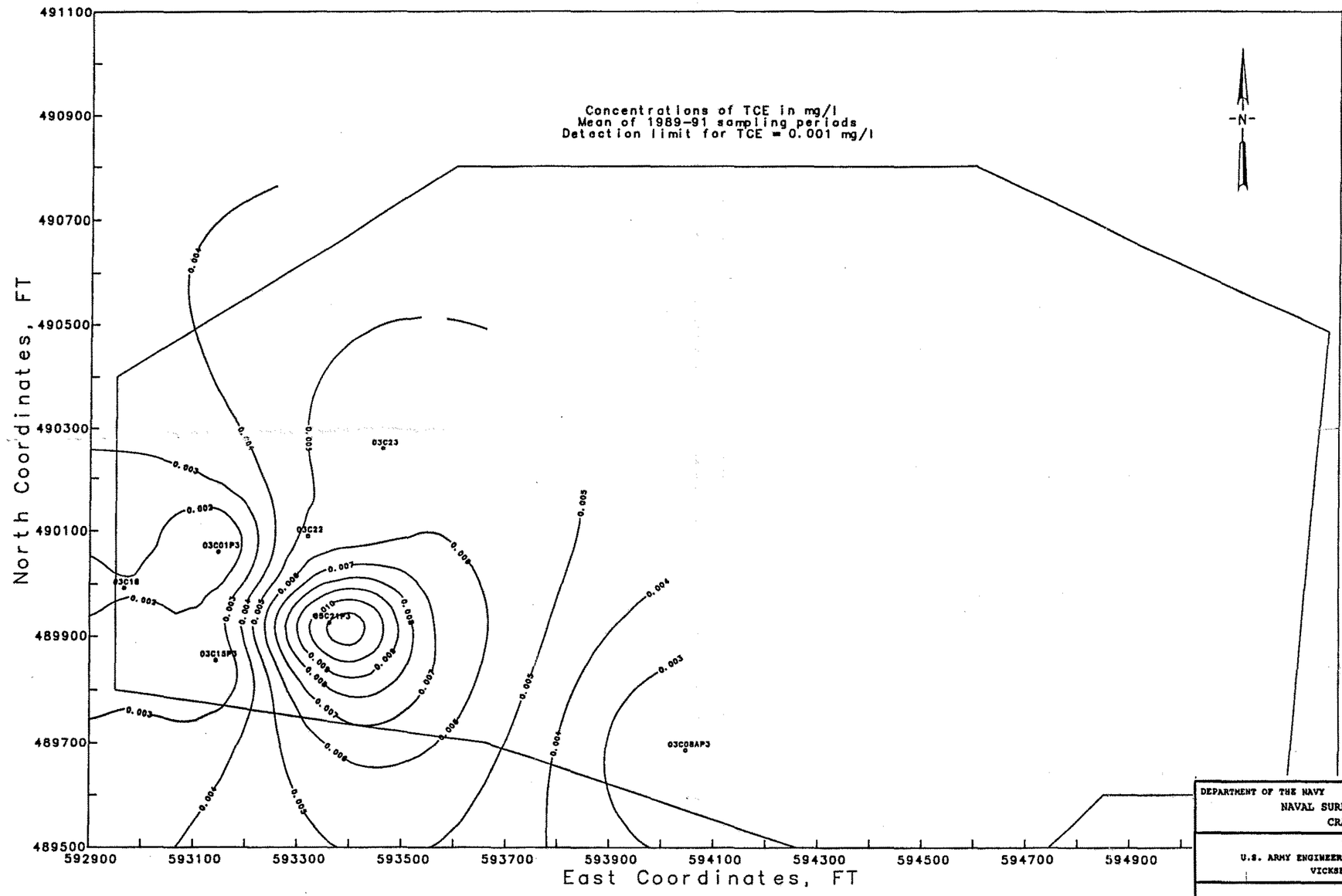
AMMUNITION BURNING GROUND
BARIUM CONCENTRATION IN BEECH CREEK WELLS
ABG STUDY AREA

0 500 1000 FT

PLATE 18

Reference: US Army Corps of Engineers, Technical Report GL-94-15, May 1994 Volume II

TCE Concentration, Golconda/Haney, ABG



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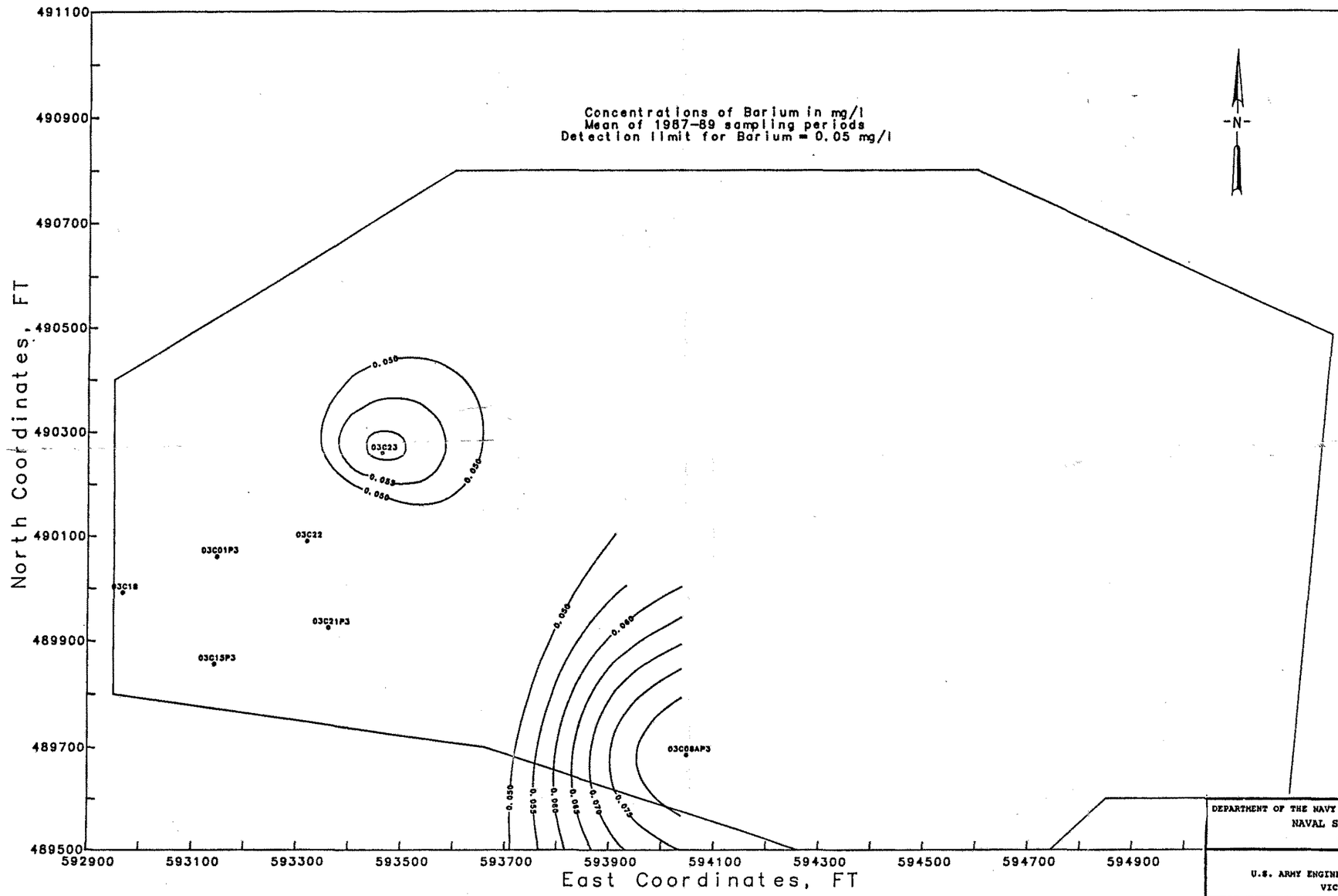
AMMUNITION BURNING GROUND
TCE Concentration
Golconda/Haney Aquifer

0 100 200 FT

PLATE 19

Reference: US Army Corps of Engineers, Technical Report GL-94-15, May 1994 Volume II

Barium Concentration, Golconda/Haney, ABG



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AMMUNITION BURNING GROUND
Mean Barium Concentration
Golconda/Haney Aquifer

0 100 200 FT

PLATE 20

Reference: US Army Corps of Engineers, Technical Report GL-94-15, May 1994 Volume II

APPENDIX 5-2

NATURE AND DISTRIBUTION OF GROUNDWATER CONTAMINATION AT THE ABG STUDY AREA

CALCULATION WORKSHEET Order No. 19116 (01-91) PAGE ____ OF ____

CLIENT		JOB NUMBER	
SUBJECT			
BASED ON		DRAWING NUMBER	
BY	CHECKED BY	APPROVED BY	DATE

This information was obtained from the Final Report, RCRA Facility Investigation, Phase III Groundwater Release Characterization, SWMU 03/10 Ammunition Burning Ground. Technical Report GL-94-15, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

5 Nature and Distribution of Groundwater Contamination

Detected Compounds

A list of parameters monitored at the ABG is presented as the first two pages of Appendix F to this report. The list is also an example of the analytical laboratory's reporting format for analytical results. Values with a "<" sign followed by values in parentheses are detection limits. Note that on some sampling dates for some wells only a partial list of parameters was sampled for (see Appendix F).

Wells

Fifty-two wells in the ABG study area have been identified as screened in the Big Clifty/Beech Creek aquifer. Nine additional wells screen the alluvium of Little Sulphur Creek. A DBase printout[1] of detected (value above detection limit) compounds or parameters for all Big Clifty/Beech Creek wells within the ABG study area is presented as Appendix G to this report. Five wells screen and sample the Beaver Bend limestone aquifer. A DBase printout of detected parameters in the Beaver Bend wells is presented as Appendix H. Eight wells screen and sample the Golconda/Haney limestone aquifer. A DBase printout of detected parameters in the Golconda/Haney aquifer is presented as Appendix J. Notable compounds detected were the explosives RDX and TNT, the volatile organic TCE, and the heavy metal barium. RDX has been shown to produce toxic effects on the human central nervous system (McLellan,et al, 1988). TNT is toxic to humans when ingested and has caused death by poisoning. TNT is also mutagenic and carcinogenic in test animals (McLellan, et al. 1988). TCE and barium are toxic to several human organs. TCE is also a carcinogen.

[1] The printouts display six columns of information: the well number, date sampled, parameter tested, a lab qualifier, the amount detected and the measurement unit, resp.

Springs

Springs A through F and Mountain Spring, all within NSWCC, were sampled six times between December 1987 and January 1992. Appendix K presents the detected parameters and amounts detected for the springs.

Statistical and Qualitative Evaluation of Data

Background

An evaluation of analytical results from sampling conducted at the ABG from September 1987 to January 1991 was conducted by Comarco, Engineering Support Division, of Bloomfield, Indiana and submitted as a report to NSWCC (Comarco, 1992). Comarco performed statistical analysis of data amenable to a t-test analysis and a qualitative evaluation of the remaining data. This section summarizes the findings of the Comarco investigation and supplemental evaluation of selected parameters for additional periods by WES.

NSWCC initiated a water quality sampling and chemical analysis program in 1987. The contractor, Anacon, Inc. of Pasadena, Texas, conducted the field collection and laboratory analysis program. Data from well 03C17 for sampling periods October 1987, January 1988, April 1988 and July 1988 were used to establish background concentrations. The groundwater monitoring and assessment plan established by NSWCC for the ABG is provided as Appendix L.

The groundwater was tested for several chemical parameters at various detection limits during the program. The EPA method numbers used by Anacon for analysis are shown in Figure 10. Monitoring of the ABG RCRA wells was performed in accordance with requirements of 40 CFR Part 265 (Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities), section 265.90, Subpart F, Groundwater monitoring. Section 265.90 specifies that three parameter groups be evaluated: (1) parameters characterizing the suitability of the groundwater as a drinking water supply (RCRA Group I, drinking water quality standards), (2) parameters establishing groundwater quality (RCRA Group II, groundwater quality parameters), and (3) parameters used as indicators of groundwater contamination (RCRA Group III, groundwater contamination parameters). Section 265.90 further specifies that each of the four contamination indicator parameters (Group III) be tested in quadruplicate for each sample so that a statistical t-test can be conducted on the data.

Analytical results by parameter group

Group III, indicator parameters. The USEPA has defined four chemical parameters as Group III indicator parameters. They are pH, specific conductance, total organic carbon (TOC) and total organic halogens (TOX). Four

replicate measurements were taken from the groundwater samples from each well at each sampling period. A statistical t-test was conducted on the indicator parameters for the Beech Creek aquifer wells only (with exceptions as noted below). An explanation of statistical methodologies used was provided by Comarco and is presented in Appendix M. The t-test compares the mean and variance of the background well(s) with those of the monitoring wells. Wells significantly different from the background well values are rejected, i.e. the wells are suggested by the t-test to be contaminated.

Wells rejected by the t-test for pH were: 03C01P2, 03C09P2, 03C20, 03C26, 03C29 and 03C30. Average pH values for these wells ranged from 9.41 to 12.6.

Well 03C15 was rejected by the t-test for specific conductance in one sampling period, October 1988. Its average value for the period was 5336 micromho/cm.

Well 03C03P2 was rejected by the t-test for TOC in one sampling period, January 1991. Its average value for the period was 63.1 mg/l.

Beech Creek aquifer wells rejected by the t-test for TOX were: 03C03P2, 03C09P2, 03C11, 03C12, 03C13, and 03C20. Well 03C08A, a Beaver Bend aquifer well, well 03C21P3, a Golconda/Haney aquifer well, and 03B02, an alluvial well south of the ABG in the valley of Little Sulphur Creek, were also rejected by the t-test for TOX.

Group I, drinking water quality parameters. Comarco divided the system of ABG wells into groups of 3, 4 or 5 wells each and compared them to the background well 03C17 for all remaining parameters. The wells compared were predominantly Beech Creek aquifer wells with some exceptions. Comparison was by line graphs showing amount of parameter detected vs sampling period. Comparisons were then made of each detected quantity for each well for each sampling period vs the detection limit and the MCL (drinking water standard). These were not statistical tests. The first group evaluated was Group I, drinking water quality parameters. Group I included arsenic, barium, cadmium, fluoride, lead, mercury, nitrate as N, selenium, silver, endrin, lindane, methoxychlor, toxaphene, 2,4-D, 2,4,5-TP, radium, gross alpha, gross beta and coliform. Table 7 summarizes the results of Comarco's Group I comparisons by listing the wells and the Group I parameters detected. The numbers in the table indicate how many times the parameter was detected in the well. Fluoride was detected in many wells but the data were not compiled in the table because the detected values were below the MCL for drinking water. Data for radium, gross alpha, gross beta and coliform were not compiled for Table 7.

The metal **barium** was detected in many wells in several sampling periods. WES conducted a separate analysis of barium data to include wells not evaluated by Comarco. **Cadmium** was detected in 11 wells at least once. **Lead** was detected in five wells in one sampling period each. **Mercury** was detected in nine wells in one sampling period each. **Nitrate** as N was

detected in 3 wells in a total of 6 sampling periods. **Selenium** was detected in four of the nine boundary alluvial wells (03B01, -B02, -B07 and -B08) in one sampling period each, but in no other wells. The background well, 03C17, had a detectable level of only one of the five metals (barium, 0.05 mg/l) on one occasion.

Barium was detected in 52 wells including 38 wells in the Big Clifty/Beech Creek aquifer, 6 wells in the alluvium of Little Sulphur Creek at the boundary south of the ABG, 7 Golconda/Haney wells and one Beaver Bend well. The boundary wells intercept groundwater emanating from the Beech Creek aquifer and Little Sulphur Creek upstream. Mean values of barium for each well were computed for sampling periods between October 1987 and July 1989 (Group 1 parameters were not sampled after July 1989). Data from seven sampling periods were available for most wells. The highest value of barium detected was 0.36 mg/l in well 03C01P2 in February 1988. Well 03B02, a boundary well, recorded a value of 0.348 mg/l in July 1988. There were no detected amounts of barium at or above the MCL of 2 mg/l. Further WES evaluation of barium data is presented below in the section on Distribution of Contaminants.

Group II, groundwater quality parameters. Group II includes chloride, iron, manganese, phenols, sodium and sulfate. Table 8 lists all wells in which amounts detected were greater than those of the background well 03C17. The background well 03C17 had significant amounts of sodium and sulfates. Wells 03B03 and 03B04 had amounts of **manganese** higher than background in as many as 10 sampling periods.

Explosives. Three explosives compounds were monitored using the high performance liquid chromatography (HPLC) method: Trinitrotoluene (2,4,6-TNT), Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), and octahydro-1,3,5,7-tetranitro 1,3,5,7-tetrazocine (HMX). The instrument detection limit for explosives varied from 0.01 to 0.02 mg/l. One well, 03C03P2, recorded **TNT** at 0.04 mg/l in one sampling period and 0.01 in another. Wells 03B06, 03C05, 03C20, and 03C26 recorded levels of **TNT** near the detection limit in one sampling period each. Two wells, 03C03P2 and 03C08AP2, recorded **HMX** in a total of 3 sampling periods.

WES performed a separate analysis of the RDX data to include wells which were not evaluated by Comarco. Mean values over all sampling periods were computed for plotting. WES counted 22 Beech Creek aquifer wells with detectable amounts of **RDX** in the sampling periods from October 1987 through January 1992. Eight of those wells were emplaced prior to 1987 and were not evaluated by Comarco (but were sampled by Anacon). RDX data for most wells was available for 18 sampling periods. The highest value of **RDX** detected was 0.709 mg/l in well 03C03P2 in April 1988. Well 03C03P2 recorded levels of **RDX** greater than 0.1 mg/l on 11 other occasions. Well 03C08P2 recorded levels as high as 0.3 mg/l and levels greater than 0.1 mg/l on seven other occasions. Well 03C20 recorded levels greater than 0.1 mg/l on six occasions. Well 03-33 recorded levels as high as 0.05 mg/l on five occasions. Well 03-35 recorded levels as high as 0.11 mg/l

once and as high as 0.09 on two other occasions. The background well, 03C17, had no detectable levels of RDX in any sampling period. Further WES evaluation of the RDX data is presented below under the section on Distribution of Contaminants.

Selected solvents. Three volatile organics (solvents) were evaluated because of their relatively common occurrence in the ABG wells. They were trichloroethylene (TCE), di-N-butyl phthalate and bis(2-ethylhexyl)phthalate. Several wells had detectable levels of **di-N-butyl phthalate** and **bis(2-ethylhexyl)phthalate**, but because the compounds are common laboratory and sampling artifacts because of their presence in analytical and sampling equipment, they were considered not to be significant.

WES performed a separate analysis of the TCE data to include wells and time periods not included by Comarco. WES evaluated 33 Beech Creek aquifer wells within the ABG for TCE. The detection limits for TCE were 0.01 and 0.001 mg/l. Twenty-two of the wells had detectable levels of **TCE** at least once between October 1987 and January 1992. The highest **TCE** concentration detected in the 11 sampling periods was 17.840 mg/l in well 03C20 in October 1990. Well 03C20 recorded values of **TCE** greater than 1 mg/l in every sampling period. Well 03C11 recorded levels higher than 1 mg/l on several occasions. Well 03C03P2 recorded levels of **TCE** as high as 0.183 mg/l. Well 03C09P2 recorded levels as high as 0.136 mg/l. The background well 03C17 had detectable levels of **TCE** in two periods prior to Feb 1990 but none since (the detected levels were 0.009 mg/l in April 1989 and 0.002 mg/l in January 1990). Many detected levels of TCE were above the MCL of 0.005 mg/l. Further evaluation of the **TCE** data is presented below under Distribution of Contaminants.

One well (03-07) in the cluster of wells on the "jeep trail" approximately a half mile below the ABG in the alluvial valley of Little Sulphur Creek was sampled by Anacon 11 times from July 1989 to January 1992. See Figure 5 for the location of the wells. Parameter groups 2 and 3, explosives (TNT, RDX and HMX) and four organics (1,1,1-trichloroethane, trichloroethylene, di-N-butyl phthalate and bis(2-ethylhexyl)phthalate) were monitored. Group 1, which includes the heavy metals, was not monitored. Well 03-07 is screened in the alluvium approximately 3 ft above the top of rock. The screen is within the projected elevation of the Beech Creek limestone in the adjacent valley walls. The well is near Little Sulphur Creek. Well 03-07 indicated the presence of TCE above detection limit in all 11 sampling periods. The highest amount detected was 7.102 mg/l in October of 1991. The average (mean) amount detected was 1.304 mg/l. There are 13 other wells in the "jeep well" cluster, but none have been sampled in the Anacon program. See Part I, History of Operations for a description of activities in the area.

Other parameters. **Bicarbonate, calcium, magnesium and potassium** were detected in significant quantities in most wells for most sampling periods. All of these compounds are listed for secondary drinking water standards only (standards for taste, odor and appearance).

Distribution of Contaminants

Evaluation of data for the Big Clifty/Beech Creek aquifer

Wells. Contaminant distribution contour maps were developed for RDX, TCE and barium for the 33 Big Clifty/Beech Creek wells within the ABG site proper by compiling the average (mean) value of the measured concentration per well over the sampling periods between October 1987 and January 1992 (all periods available at the time of report preparation). Because barium was also detected often in wells within the ABG study area but outside the ABG proper, an additional map was prepared for barium distribution in the larger study area. Barium is not a particularly toxic compound (its MCL is 2 mg/l), but it was the prevailing heavy metal (primary-MCL metal) detected in the ABG study area, it was detected on multiple occasions in many wells, and it occurred in a pattern indicating a potential source within the ABG. Therefore, distribution maps were prepared for barium.

For a given well, if there was at least one sampling period in which the compound was detected, the mean was calculated by summing all values (including a value of 1/2 the detection limit for amounts less than detection[2]) and dividing by the number of sampling periods. If no detectable quantities were reported in the sampling periods, the value for the well was recorded as zero. The mean values were then contoured using an inverse-squared gridding algorithm (influence of well value decreases as the inverse of the square of the distance to the neighboring well).

The TCE mean values were calculated only over 11 periods because the detection limit improved by a factor of 10 after 1988. The detection limit was 0.01 mg/l for October 1987 through January 1989, but was improved to 0.001 mg/l starting with the April 1989 sampling period. Because of the magnitude of the change in detection limit, the pre-1989 data were discarded and the mean TCE values were calculated using only the later data.

Contour maps of average contaminant concentrations for RDX, TCE and barium in the ABG site proper are presented as Plates 14, 15 and 16, respectively. Plate 17 is a reference map of well locations within the ABG site at the scale of the contour maps. The map for barium for the ABG study area is presented as Plate 18. The minimum value contoured on each map was 0.02 mg/l for RDX, 0.001 mg/l for TCE and 0.05 mg/l for barium (the detection limits for the compounds). The numbers at the wells on Plates 14, 15 and 16 are the calculated mean values in mg/l. The highest mean value for **RDX** over the 18 periods was 0.186 mg/l in well 03C03P2. The highest mean value for TCE was 5.686 mg/l in well 03C20. The highest mean value for **barium** in the ABG site proper (Plate 16) was 0.092 mg/l in well 03C08AP2 and in the ABG study area (Plate 18) was 0.131 mg/l in boundary well 03B03. The TCE contaminant values were contoured using the logarithm

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[2] Statistical analysis permits setting values less than detection at one-half the detection limit.

of the values because the range of mean values was high (0.0006 to 5.686 mg/l).

The contour maps portray the general distribution of the contaminants in the Beech Creek aquifer at the ABG site within the time frame from October 1987 through January 1992 (through July 1989 for barium). Only wells within the ABG site proper (Plate 14) recorded detected values for RDX. TCE was recorded in wells outside the ABG site (within the ABG study area) only sporadically (one-time occurrences at a few wells). Therefore, contour maps were not appropriate for RDX and TCE for wells outside the ABG site proper. A notable exception was the occurrence of TCE in the alluvial well 03-07 on the "jeep trail." RDX also occurred in Spring A, south of the ABG.

The contour map for RDX (Plate 14) indicates that the compound was most highly concentrated in the aquifer in the central and south central portions of the ABG, particularly in wells 03C03P2, 03C08AP2 and 03C20. Well 03C03P2 is adjacent to the burn pads (Areas 2 of Plate 1). Wells 03C08AP2 and 03C20 are near the former ash pile and the incendiary cage (Area 8 of Plate 1). All three wells are near potential sources of explosvies contamination. A similar distribution was shown for TCE on Plate 15, with highest concentrations near the center and south-central portions in wells 03C03P2, 03C11, and 03C20. Another high concentration of TCE was indicated around the cluster of wells 03C09P2, 03-38 and 03-39 northwest of 03C03P2. Well 03C03P2 is near the fuel oil storage tank (Area 13 of Plate 1), well 03C11 is near the solvent burn pans (Area 9) and well 03C20 is near the former ash pile. These three wells are near potential sources of solvent contamination. The distribution of both compounds generally coincides with the position of the subcrop[3] of Big Clifty sandstone exposed downslope of its contact with the Indian Springs shale (the dashed boundary on Plates 14 and 15). Hunt (1988) stated that the Indian Springs shale was a barrier (aquiclude) to infiltration of surface and upper aquifer waters into the Big Clifty/Beech Creek system in the western part of the ABG. Concentration of RDX and TCE in the Big Clifty/Beech Creek aquifer near the Indian Springs/Big Clifty contact seems to corroborate Hunt's interpretation. The scarcity of RDX and TCE detected in monitoring wells southeast of well 03C11 (Plates 14 and 15) is possibly a result of dilution or flushing of contaminants in the high gradient, high flow-velocity karst conduit flow system there (see Plate 13 and Figure 8).

The distribution map for barium in the ABG site proper (Plate 16) shows the metal concentrated near the central and south central ABG, similarly to the RDX and TCE distributions, and around well 03C01P2 near the western extent of the site. The distribution map for the larger study area (Plate 18) indicates that barium in the Beech Creek aquifer extends outside the ABG proper to wells just south of the site (03C30 and 03C31) and that it occurs locally near the easternmost boundary wells in the alluvium of Little Sulphur Creek. The proposed background well, 03C17, had only one detected value

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[3] The subcrop is the exposed surface of the Big Clifty if the overlying colluvial and alluvial soil cover were removed.

(0.05 mg/l) in the seven periods in which it was sampled. Ten monitored Beech Creek wells had no detectable amounts of barium in the periods sampled. The distribution of barium in the groundwater and the absence of the compound in many wells strongly indicates that barium is an operations contaminant for the ABG and not a naturally occurring compound. Barium is a component of some pyrotechnics, which have been burned at the ABG. Barium mixtures are used as oxidizers and as color intensifiers in pyrotechnics (Eakes et al, 1983).

Springs. The six sampling periods for the springs were December '87, July '89, October '89, April '90, April '91, September/October '91 and January '92. Spring A was sampled alone in February of 1990 following the first dye tracer test. Notable compounds detected were as follows (see Appendix K): Spring A recorded detected levels of RDX on five occasions in amounts as high as 0.14 mg/l and TNT on one event (0.03 mg/l). Spring A also recorded the heavy metal barium three times (maximum level was 0.14 mg/l). Nitrates (as N) were detected in Spring A three times but at levels below the MCL of 10 mg/l. Spring A indicated gross Beta radiation greater than the MCL of 4 mrem/y on three occasions.

Spring B recorded trichloroethene (trichloroethylene or TCE) at 0.139 mg/l once and barium twice. Spring B indicated gross alpha radiation above MCL of 15 pCi/L once and gross beta once above MCL.

Spring C recorded RDX at the detection limit (0.02 mg/l) and TCE on one event each, and barium twice. Nitrates (as N) were detected in Spring C three times at about the same levels as in Spring A. Spring C indicated gross beta at 7.7 mrem/y (above MCL) once.

Spring D recorded RDX once at 0.03 mg/l, TCE once at 0.016 mg/l and barium once. Spring D indicated gross beta above MCL of 4 mrem/y twice and gross alpha at the MCL of 15 pCi/L twice.

Spring E recorded barium and di-N-butylphthalate once each. Spring E indicated gross beta once above MCL.

Spring F recorded mercury once at 0.002 mg/l and barium twice. Mountain Spring recorded methoxychlor once at 0.100 mg/l and barium twice. Spring F indicated gross alpha and beta radiation above MCL once.

Springs B, D, E and F showed the high values of gross alpha and beta radiation on the April 1991 sampling date only. The reported values of gross radiation for that date are suspect. Other parameters detected in springs B, D, E and F were below primary MCLs. There were some parameters above secondary MCLs on some sampling dates.

The dye tracer test confirmed the hydraulic connection to the ABG of the Beech Creek limestone conduits that feed Spring A. Dye trace results indicated that Spring C was hydraulically connected to the ABG under limited conditions, and Spring B under even more restricted conditions. Springs A, B

and C release their groundwater to surface drainage which ultimately enters Little Sulphur Creek south of the ABG. Any remediation or future monitoring of release to the Beech Creek aquifer of ABG contaminants should accommodate the area of Springs A, B and C and of the surface waters released from them.

Evaluation of data for the Beaver Bend aquifer

Water quality data were compiled for the five Beaver Bend wells for the period October 1987 through January 1992. The sampling history of the five wells (03C01, 03C02, 03C03, 03C08A and 03C09) is summarized in Appendix F. All five parameter groups were tested through July 1989, but Group 1 was not tested after that date. Group 2 was not tested in sampling periods after July 1989. Parameters from all groups were detected in the Beaver Bend wells. A DBase printout of compounds and parameters detected in the Beaver Bend wells is presented in Appendix H.

Of the explosives tested, **RDX** was detected in two wells, 03C01 and 03C09. **RDX** was detected in 03C01 in January and December 1991 at 0.02 and 0.03 mg/l, respectively. **RDX** was detected in 03C09 in October 1989 at 0.23 mg/l. No other explosives were detected in Beaver Bend wells.

Organic compounds, particularly **TCE**, were detected in all five Beaver Bend wells. For TCE, only data for DL of 0.001 were evaluated. Table 9 summarizes the occurrence of organic compounds in the Beaver Bend wells. For data with a DL of 0.001 mg/l (i.e. later than March 1989), wells 03C01 and 03C09 recorded detectable levels of TCE on three occasions, (counting trichloroethene). The highest level of **TCE** was 0.007 mg/l in 03C09. **TCE** was also detected at least once in each of the other wells. Other organics detected were **1,1-dichloroethene** (one well), **benzene** (three wells), **chloroform** (one well), **1,1,1-trichloroethane** (one well), **bis(2-ethylhexyl)-phthalate** (three wells), and **di-N-butylphthalate** (one well).

Three heavy metals were detected in Beaver Bend wells. **Barium**, as high as 0.056 mg/l, was detected in well 03C09 in four periods. **Cadmium**, as high as 0.09 mg/l, was detected in well 03C02 once and 03C03 twice. **Mercury**, as high as 0.014 mg/l, was detected in well 03C02 once and in 03C09 once. Note that heavy metals (Group 1 parameters) were not tested for after July, 1989. The background well, 03C17, had a detectable level of only one of these three metals (barium, 0.05 mg/l) on one occasion.

Evaluation of data for the Golconda/Haney aquifer

Eight wells were screened in the Golconda/Haney limestone, the uppermost aquifer at the ABG. The wells were 03C01P3, 03C08AP3, 03C15P3, 03C18, 03C19P3, 03C21P3, 03C22 and 03C23. The sampling history of the Golconda/Haney wells is provided in Appendix F. Wells 03C01P3, 03C08AP3, 03C15P3 and 03C18 were sampled in 18 periods between

Oct 1987 and January 1992. Well 03C19P3 was sampled in only 10 periods. Well 03C21P3 was sampled in 14 periods and wells 03C22 and 03C23 in 17 periods. Group 1 drinking water parameters, which include the heavy metals, were not sampled after July 1989. All of the wells are located in the western or southern portions of the ABG (see Plates 1 and 2). A DBase print-out of detected compounds in the Golconda/Haney is presented in Appendix J.

The explosive compound **RDX** was detected in only one Golconda/Haney well, 03C08AP3, twice in 1988 and once in July 1991. The highest detected amount of RDX was 0.03 mg/l (detection limit was 0.02 mg/l).

Several organic compounds were detected in several wells. The volatile organic **TCE** was detected three times each in 03C01P3, 03C08AP3, 03C21P3 and 03C23, once in 03C15P3, four times in 03C18, twice in 03C19P3, and five times in 03C22 (TCE was evaluated only for the 0.001 mg/l DL). The highest amount of TCE detected in one sampling event was 0.067 mg/l in 03C22. TCE exceeded its MCL of 0.005 mg/l in wells 03C08AP3 (once), 03C15P3 (once), 03C18 (once), 03C21P3 (twice), 03C22 (once), and 03C23 (once). Plate 19 is a contour map of mean TCE concentration for the sampling periods April, 1989 to January, 1992. The map emphasizes the highest mean level of TCE detected in well 03C21P3, at 0.0126 mg/l. A weighted contouring algorithm that minimizes the influence of adjacent data points (inverse square of distance) was used to bias the interpretation of contaminant distribution toward point sources near the wells.

Other organic compounds detected in more than one well or more than one period were **di-N-butyl phthalate** (three wells), **bis(2-ethylhexyl)phthalate** (five wells), **benzene** (3 wells), **carbon tetrachloride** (two wells), and **chloroform** (one well). The pesticide **2,4,5-TP** was detected once in well 03C01P3 in 1987 and once in well 03C22 in 1988. All of the benzene amounts exceeded the MCL of 0.005 mg/l. Both carbon tetrachloride amounts exceeded the MCL of 0.005 mg/l. It should be noted that benzene and carbon tetrachloride were detected only on the first sampling event (Fall, 1987), and were not detected subsequently. No other organics exceeded existing MCLs.

Four heavy metals (Group 1) were detected in Golconda/Haney wells. **Barium** was detected once in 03C01P3, five times in 03C08AP3, twice in 03C18, 03C19P3, 03C21P3 and 03C22, and four times in 03C23. The highest amount detected of barium was 0.14 mg/l in well 03C08P3 (MCL for barium is 2 mg/l). **Cadmium** was detected once in well 03C18 (0.05 mg/l) and once in well 03C23 (0.04 mg/l). Both cadmium amounts were above the MCL of 0.005 mg/l. **Mercury** was detected once in well 03C19P3 at 0.008 mg/l (above the MCL of 0.002 mg/l). **Selenium** was detected once in well 03C22 at 0.006 mg/l (MCL is 0.05 mg/l). The background well, 03C17, had a detectable level of only one of these four metals (barium, 0.05 mg/l) on one occasion. Plate 20 is a contour map of mean barium concentration in the Golconda/Haney wells for available sampling periods. The map reflects the highest levels in wells 03C08AP3 and 03C23.

The migration characteristics of Golconda/Haney groundwater were presented earlier.

Extent of Contamination

The extent of contamination of the groundwater by sources at the ABG is discussed for each of the three aquifers described earlier in this report: the uppermost aquifer, the Golconda/Haney limestone; the middle and primary aquifer, the Big Clifty sandstone/Big Clifty limestone; and the lower aquifer, the Beaver Bend limestone. Determination of the extent of contamination in each aquifer was made from evaluation of the groundwater quality data obtained by the contractor, Anacon, during the period September 1987 through January 1992.

Golconda/Haney limestone aquifer

The Golconda/Haney limestone at the ABG was described above. The formation occupies the northern, southern and western fringes of the ABG site, west and north of the ABG, and south along the ridge between Johnson Hollow and Little Sulphur Creek, but is daylighted (removed by erosion) in the center of the ABG site and in the valleys of Johnson Hollow and Little Sulphur Creek to the southwest and east ~~see Plate 5)~~. Groundwater flow in the monitored portion of the Golconda/Haney at the ABG is toward the east and north from the west and south, where the formation drains into the valley. Contamination in the Golconda/Haney, which has been shown to be primarily TCE, is probably limited to the southwest quadrant of the ABG with ultimate migration into the lower Big Clifty/Beech Creek aquifer in the central and east portions of the ABG. The base of the Golconda/Haney in the vicinity of the ABG is at about 590 ft NGVD minimum, at least 90 ft above the valley floors, and is underlain by the Indian Springs shale aquiclude.

Big Clifty sandstone/Beech Creek limestone aquifer

The Big Clifty/Beech Creek aquifer, as discussed earlier in this report, is infiltrated, or recharged, by precipitation and runoff from a large portion of the ABG and is directly accessible by percolating contaminated groundwater. The karst solution channels in the Beech Creek limestone have been shown to transport Beech Creek groundwater rapidly to the southeast away from the ABG within the valley of Little Sulphur Creek. The Elwren shale aquiclude at the base of the Beech Creek disperses the groundwater laterally within the Beech Creek. The Beech Creek discharges groundwater back to the surface at the springs in the valley of Little Sulphur Creek. The Beech Creek and its springs are exposed in the valley at least as far as 3-1/2 miles south of the ABG (see Plate 2). Water issuing from the springs recharges Little Sulphur Creek year round.

The extent of contamination in the Big Clifty/Beech Creek aquifer for the parameters RDX, TCE and barium was presented graphically by the contaminant concentration contour maps, Plates 14, 15, 16 and 18. Only barium was shown to be present outside the ABG site proper. However, Spring A, the primary outlet for Beech Creek groundwater, had detected levels of RDX, TNT and barium. Spring C, located on the eastern side of the valley of Little Sulphur Creek and north of Spring A, had detected levels of RDX only once and at a just-detectable level. Spring C was shown by tracer tests to discharge groundwater originating at the ABG only at high flow, for example, following periods of high or extended precipitation. Spring C and other springs would be more effectively monitored by a sampling system or program that sampled on-demand, i.e. during high flow conditions.

Little Sulphur Creek discharges its waters into its alluvium and downstream beyond the boundary of NSWCC. The alluvial wells (03B01 through 03B09) have not shown persistently detectable levels of contaminants attributable to ABG activities except for the heavy metal barium (see Plate 18). Surface water and bottom sediment sampling of Little Sulphur Creek were conducted in the spring and in the summer (two rounds) of 1992. Preliminary analysis of the data indicates that certain explosives, organic compounds, metals and nitrates have accumulated in the surface water and bottom sediments of Little Sulphur Creek. Two of 11 surface water sampling sites, located immediately below and 1/4 mile below the ABG site, generally showed higher frequency and quantity of explosives and metals contamination than the other sites. Explosives in sediments generally were detected at more sites and at higher levels within the ABG site than below it. Generally, contaminants were detected more frequently in bottom sediments of Little Sulphur Creek than in its waters. A draft report of the surface water investigation is in preparation (Murphy and Wade, 1993).

Contamination by explosives of the groundwater of the Big Clifty/Beech Creek system and to the surface water and the alluvial groundwater that it recharges south of the ABG extends south beyond the ABG at least as far as the mouth of Spring A and the vicinity of monitoring well 03C38 in Little Sulphur Creek. Other compounds including certain volatile organics and heavy metals occur in the waters as far south as the NSWCC boundary across Little Sulphur Creek.

Beaver Bend limestone aquifer

The Beaver Bend limestone aquifer was shown to be hydraulically separate from the Big Clifty/Beech Creek aquifer, exhibiting a piezometric differential of some 35 to 45 ft (Hunt, 1988). Explosives, organics and heavy metals were detected in the Beaver Bend, as discussed above, but in relatively low concentrations compared to levels in the Big Clifty/Beech Creek. The five wells monitoring the Beaver Bend are in the ABG site proper (wells 03C01, 03C02, 03C03, 03C08A, and 03C09 of Plate 3 and Figure 9). It is not possible to determine the extent of contamination in the Beaver Bend beyond the ABG without further well emplacement, if action levels for detected

contaminants necessitate expansion of the monitoring program. The existing Beaver Bend wells should continue to be monitored to determine its groundwater quality.

Contaminant Fate and Transport

A discussion of contaminant fate is a prediction of the long-term disposition of a contaminant in the environment. Transport is the mechanism by which the contaminant is inserted and dispersed into the environment from its source. This discussion is limited to the notable compounds discussed above, i.e. RDX, TCE and barium and the heavy metals in general.

Explosives

RDX was one of many explosives burned at the ABG. Composition B (see History of Operations, this report) is a mixture of RDX and TNT. RDX has a low solubility in water (reported values of 7.6 to 42 mg/l, or 0.00076 to 0.0042 percent at 20° C.) and a low leachate level by downward percolation through contaminated soils (McLellan, Hartley and Brower, 1988(1)). McLellan, Hartley and Brower also reported that RDX resists aerobic degradation in soils and does not volatilize significantly, but degrades rapidly by photolysis[4] (1988(1)). The low water solubility of RDX (and indeed of the associated explosives compounds HMX and TNT, which have degradation characteristics similar to those of RDX) means that the compound will be released from contaminated soils slowly, will migrate to the water table slowly, and will result in low concentrations in the groundwater. The slow degradation of RDX in the absence of light should result in slow but long-term release to the water table by leaching. Once RDX-contaminated groundwater is released to surface waters, e.g. through springs, degradation by photolysis should proceed. Etnier (1986) reported sunlight photolysis degradation rates for RDX of 3 to 9 days. Studies of HMX indicated a half-life of 4 to 5 days for a 0.5 parts per million (ppm) concentration of HMX in water when exposed to natural sunlight (McLellan, Hartley and Brower, 1988(2)).

TCE

TCE is a widely used dry cleaning fluid, a degreasing and drying medium for metals and electronic parts and has a number of other industrial uses. Waste solvents containing TCE from Crane operations have been burned in pans at the ABG and are a potential source of the compound (see map, Plate 1). The transport and fate of organic contaminants such as TCE in the subsurface is a complicated topic being actively researched at this time. Several factors or mechanisms affect the movement and fate of organics through

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[4] Photolysis is chemical decomposition by the action of light.

the soil and groundwater, including volatilization to the air, adsorption of solutes onto saturated and unsaturated soils, biodegradation under aerobic and anaerobic conditions, and multi-phase transport of immiscible organic compounds in groundwater in bulk, dissolved and vapor phases (Canter, Knox and Fairchild, 1987). TCE has a weak solubility in water (1,100 mg/l or 0.11 percent at 20° C, in Montgomery and Welkom, 1990), but is many times more soluble than RDX, for example. TCE is denser than water, with a specific density of 1.46 at 20° C. The volatility of TCE and similar organic compounds implies that it would be removed rapidly from waters introduced back into the subaerial environment, for example where groundwater springs discharge the Beech Creek aquifer waters into the valley of Little Sulphur Creek south of the ABG.

Metals

Canter, Knox and Fairchild (1987) listed four major reactions of heavy metals with soils: adsorption, ion exchange, chemical precipitation and complexation with organic substances. They cite studies showing that adsorption seems to be the most important attentuation mechanism for metals. Adsorption to soil is in turn influenced by soil type. Clays and organic soils retain metals more effectively because of their capacity for cation exchange. Once in the groundwater, metal ions are carried downgradient to form a contaminant "plume" that can be detected by monitoring wells. Advection, movement of the metals under the influence of the hydraulic gradient, is the dominating mechanism driving the contaminants into and through the aquifer. Dispersion of the waterborne contaminants along and laterally from the direction of advection occurs primarily by mechanical mixing and secondarily by molecular diffusion from an area of higher concentration to an area of lower concentration (Driscoll, 1986). Barium and other heavy metals would be expected to remain in ionic form in the groundwater even if the water were discharged back to the surface at springs.

APPENDIX 5-3

NATURE AND DISTRIBUTION OF GROUNDWATER CONTAMINATION AT THE DEMOLITION RANGE AND OLD RIFLE RANGE

CALCULATION WORKSHEET Order No. 19116 (01-91) PAGE ____ OF ____

CLIENT		JOB NUMBER	
SUBJECT			
BASED ON		DRAWING NUMBER	
BY	CHECKED BY	APPROVED BY	DATE

This information has been obtained directly from the Draft Report, RCRA Facility Investigation, Phase II Groundwater Release Assessment, SWMU 06/09 Demolition Area & Phase III Release Characterization, SWMU 07/09 Old Rifle Range, Naval Surface Warfare Center, Crane, Indiana. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

6 Nature and Distribution of Groundwater Contamination

Detected Compounds

Appendix E is a printout of all compounds detected at any quantity in four rounds of sampling of monitoring wells at the Demolition Area and Old Rifle Range. Only inorganics (metals, cyanide, sulfides, nitrates and nitrites) and the organic compounds, explosives, were detected in significant and verifiable quantities. Other organics including volatiles, semivolatiles (BNAs), pesticides, herbicides and PCBs were not detected in significant and verifiable quantities. Appendix E-1 is a series of tables of amounts detected of metals in Demolition Area/Old Rifle Range wells, sorted in order of amount detected, highest value first (descending order). Appendix E-1 readily shows the persistence of certain metals in particular wells.

WES used two methods to evaluate the significance and distribution of metals in the groundwater: statistical and graphical. The statistical analysis follows the USEPA guidance for evaluation of groundwater monitoring data. The graphical approach, using bar charts, permits a visual comparison of results and supplements the statistical analysis. Only metals were analyzed statistically. Metals, explosives and nitrogen compounds were evaluated graphically.

Statistical and Qualitative Data Evaluation

Selection of methods

Statistical analysis of metals concentrations reported for four rounds of sampling conducted between November 1990 and April 1992 in Demolition Area/Old Rifle Range wells was accomplished using the analysis of variance (ANOVA) statistical method suggested by USEPA. Guidance for selecting and applying the statistical analysis was provided in "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance", April, 1989 (EPA, 1989). The actual analysis and reporting of results was performed on a personal computer using the Groundwater Information Tracking System/Statistics (GRITS/STAT) software and manual developed for USEPA by Alliance Technologies Corporation (1992) and provided to the

author by USEPA Region V (Chicago). The one-way parametric ANOVA statistical analysis method is recommended for detection and compliance monitoring data for which more than 50 percent of the values are above the detection limit (DL). The method compares data from detection or compliance (downgradient) wells to data from background (upgradient) wells. Compounds that commonly are present in background wells, for example naturally occurring metals, are most appropriately evaluated using ANOVA. If contamination of the groundwater occurs from facility activities and if the monitoring wells are hydraulically upgradient and downgradient from the activity, then contamination is unlikely to change the levels of a constituent in all wells by the same amount. Contamination from an activity can be seen as differences in average concentration among wells, and such differences can be detected by analysis of variance.

The ANOVA method checks the distribution of the observed data for certain statistical characteristics (normality and equal variance). If the checks fail, an analysis of the log-transformed[4] data is performed and checked. If the tests fail again, a non-parametric analysis of variance is performed to determine the likelihood of contamination of the wells.

Statistical procedures

ANOVA calculates the differences between the average (mean) concentrations in each well (X_i) and the mean concentrations in the background well (X_b), the means having been computed over the N number of sampling periods (in this case, N = 4). It then compares the differences to a statistical, tabulated value, D_i. If the difference (X_i - X_b) is greater than D_i, the method concludes that the "i"th well has significantly higher concentrations than the average background well, and that therefore it is contaminated. The software GRITS/STAT automatically performs all statistical analyses and data normality checks for each selected parameter and prints a report of the analysis. A non-detect reported for a parameter for a sampling round is assigned a value of one-half the detection limit (not zero) by the software for statistical calculations.

Appendix G is a reproduction of selected portions of the Guidance Manual explaining the method selection and analytical techniques for compliance monitoring data. The Appendix also provides a step-by-step example of statistical analysis of a hypothetical group of wells monitored for lead contamination.

A typical computer-generated statistical analysis for monitoring wells for metals contamination at the Demolition Area/Old Rifle Range proceeded as follows:

1. A list of all wells of a selected aquifer, the concentrations of all metals reported for the wells in four rounds of sampling, and the sampling dates were first entered into the software's database.
2. A background well was selected for the aquifer. Compliance wells (the

[4] For log-transformed data, the logarithms of the values, rather than the actual values of the data, are plotted.

remaining sampled wells in the aquifer) were selected.

3. A parametric ANOVA of the original data was run for the selected metal. The software performed two tests on the data to determine whether the method was acceptable. The first test was the Shapiro-Francia or the Shapiro-Wilks[5] test on the pooled residuals (the residual was the difference between the actual observation, or value, and its predicted value, which was the mean for four rounds). The first test determined whether the values were normally distributed. The second test was Levene's test for variance. If either test failed, the one-way parametric ANOVA test for original data was concluded to be inappropriate for the data. If both tests passed, a list of wells with significant evidence of contamination with the selected metal was produced.

4. If either of the original data tests failed, a parametric ANOVA of the log-transformed data was performed and the tests for normality and variance were run again. Log-transformed data sometimes conform to a normal distribution when the original data do not. If both tests passed, a list of probably contaminated wells was produced. If either test failed, the one-way parametric ANOVA for log-transformed data was concluded to be inappropriate, and a non-parametric ANOVA was performed to estimate probability of contamination in the wells.

5. If the parametric ANOVA test was found to be inappropriate, a non-parametric ANOVA test was performed on the data. The non-parametric ANOVA applies a procedure called the Kruskal-Wallis test. The procedure tests the hypothesis that all wells or groups of wells around a source area have the same median concentration of a given constituent. Non-parametric ANOVA is appropriate when the data or residuals from a parametric ANOVA are significantly different from normal and when a log transformation fails to normalize the data. If the wells are found to differ, additional comparisons are made to determine if contamination is likely to exist. Observations in each well were ranked to compute the Kruskal-Wallis statistic, H, which then was compared to another tabulated value from the Chi-squared (χ^2) distribution. If $H > \chi^2$, the data were not normally distributed, the hypothesis that the wells have the same median concentration of the constituent was rejected, and another test was conducted. The difference between the rank average of each well and the rank average of the background well was computed. If the computed difference was greater than a critical difference calculated for the wells, there was considered to be evidence of contamination in the tested well. Statistical analyses were conducted for three aquifers: the Big Clifty/Beech Creek aquifer for the entire study area; the uppermost aquifer at the Old Rifle Range; and the upper Pennsylvanian aquifer at the Demolition Area.

Results of statistical analyses for metals

Big Clifty/Beech Creek aquifer. Statistical ANOVA evaluation of 18 Demolition Area/Old Rifle Range wells screened in the lower portion of the

[5] The Shapiro-Francia test is performed for data with > 50 observations. The Shapiro-Wilks test is performed for data with < 50 observations.

Big Clifty/Beech Creek aquifer were performed for 13 heavy metals (metals listed for primary MCLs). The metals were aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, vanadium, and zinc. All of the selected metals were detected in more than one sampling round or in more than one well. Beryllium, mercury, selenium, silver, thallium and tin were not detected more than once each in the 18 wells. The sampling populations were comprised of all 18 wells, including those with no detected levels of a metal.

Well 06C07 was selected to be the background well for the statistical tests. Well 06C08 was originally intended to serve as background but was found to be higher in metals concentrations and in frequency of metals detected than many of the down-gradient compliance wells. Well 06C07, although topographically downslope from the Demolition Area, is laterally positioned from the Demolition Area active zone with respect to the direction of flow on the Big Clifty/Beech Creek piezometric surface, as shown by Figures 22 and 23. Well 06C07 also had relatively few detected metals and the metals were at low concentrations.

Only two metals, antimony and cobalt, were able to be analyzed using the one-way parametric ANOVA test (i.e, only the data for antimony and cobalt passed the statistical normality tests performed in the parametric ANOVA). The data for all other metals failed either the Shapiro-Francia/Wilks test or the Levene test, or both. Log-transformed data also failed one or both tests. All metals except antimony and cobalt were subsequently analyzed using the non-parametric ANOVA test. Computer-generated printouts of the test data for each metal are presented in Appendix H. The last page of the non-parametric ANOVA test results lists the rank differences for each well and the critical difference. A rank difference greater than the critical difference indicated significant evidence of contamination. Evidence was shown for contamination in one or more wells of the lower Big Clifty/Beech Creek aquifer by three metals: aluminum, arsenic and manganese. The results of all tests are summarized below.

Aluminum: Non-parametric test. Well 06C08 had significant evidence of contamination with respect to the background well 06C07. The well had a rank difference of 37.25 compared to a critical difference of 34.43.

Antimony: No wells showed evidence of contamination.

Arsenic: Non-parametric test. Wells 06C03 and 06C08 had significant evidence of contamination. 06C03 had a rank difference of 40.25 and 06C08 a difference of 37.25 compared to the critical difference of 34.43. Well 06C18 had a rank difference of 30.13 and might be considered borderline for arsenic contamination (note that well 06C18P2, the upper well of this cluster, had significant evidence of arsenic contamination, as discussed below in the Old Rifle Range uppermost aquifer analysis.

Barium: No wells showed evidence of contamination.

Cadmium: No wells showed evidence of contamination.

Chromium: No wells showed evidence of contamination.

Cobalt: No wells showed evidence of contamination.

Copper: No wells showed evidence of contamination.

Lead: No wells showed evidence of contamination.

Manganese: Non-parametric test. Six wells, 06C02, 06C03, 06C04,

06C12, 06C14, and 06C18 had significant evidence of contamination. Rank differences were from 35.63 (06C04) to 59.13 (06C03) compared to the critical difference of 34.43. Two other wells, 06C01 and 06C06, were borderline with differences of 33.13 and 32.25, resp.

Nickel: No wells showed significant evidence of contamination, but well 06C17 had a rank difference of 28.25 compared to the critical difference of 34.42 and bears watching in future monitoring.

Vanadium: No wells showed evidence of contamination.

Zinc: No wells showed evidence of contamination.

Old Rifle Range, uppermost aquifer. The uppermost aquifer of the Old Rifle Range consists of wells screened in the alluvium and in the upper portion of the Big Clifty sandstone beneath the Old Rifle Range study area (the area of Figure 4). The deeper wells of this cluster (e.g. 06C18) screen the lower Big Clifty/Beech Creek aquifer and were included in the Demolition Area/Old Rifle Range Big Clifty/Beech Creek aquifer wells discussed earlier). Statistical ANOVA evaluation of 15 wells (8 RFI wells and 7 confirmation wells) screening the uppermost aquifer was performed for 14 heavy (primary MCL) metals. The metals were aluminum, arsenic, antimony, barium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, tin, vanadium and zinc. The selected metals were detected in more than one sampling round or in more than one well. The sampling populations were comprised of all wells screening the aquifer.

Well 06C07, the background well for the Demolition Area/Old Rifle Range statistical tests, was used as the background well for the Old Rifle Range uppermost aquifer evaluation. Well 06C07 screens the same geologic formation as the wells at the Old Rifle Range and is desirable as background for the reasons noted earlier.

All metals data failed the two parametric ANOVA statistical normality tests and were evaluated using the non-parametric ANOVA. The computer-generated printouts of the test results are presented in Appendix I . The last two pages of the printout for the non-parametric test data list the rank differences for each well and the critical difference for the well population. Contaminated wells are starred. Evidence was shown for contamination by three metals: **arsenic, manganese and nickel.** One well could be considered borderline for zinc contamination. The results are summarized below.

Aluminum: No wells showed evidence of contamination.

Antimony: No wells showed evidence of contamination.

Arsenic: Well 06C18P2 had significant evidence of contamination. The well ranked 31.5 compared to a critical difference of 30.59 (note that well 06C18, the deeper well of the cluster, was borderline for arsenic contamination). Well 06C13P2 ranked 26.25 and bears watching in future monitoring.

Barium: No wells showed evidence of contamination.

Cadmium: No wells showed evidence of contamination.

Chromium: No wells showed evidence of contamination.

Cobalt: No wells showed evidence of contamination.

Copper: No wells showed evidence of contamination.

Lead: No wells showed evidence of contamination.

Manganese: Four wells showed evidence of contamination with the non-parametric test. Well 06-19 ranked 32.63, well 06C11P2 ranked 32.25, well 06C13P2 ranked 38.25 and well 06C18P2 ranked 45.00 compared to a critical difference of 30.59 (note that well 06C18, the deeper well of the cluster, had significant evidence of manganese contamination). Wells 06-17, 06C12P2 and 06C16P2 ranked higher than 24 and bear watching in future monitoring.

Nickel: Well 06-17 had significant evidence of contamination with a rank difference of 35.50 compared to the critical difference of 30.59.

Tin: No wells showed evidence of contamination.

Vanadium: No wells showed evidence of contamination.

Zinc: No wells showed evidence of contamination, but well 06-17 had a rank difference of 27.75 compared to the critical difference of 30.59 and bears watching.

Demolition Area, Upper Pennsylvanian aquifer. Statistical ANOVA evaluation of 5 wells screened in the upper Pennsylvanian section atop the Demolition Area ridge was performed for 14 heavy metals (metals listed as primary MCLs). The metals were aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, vanadium and zinc. All of the selected metals were detected in more than one well or in more than one sampling period. Well 06-01A served as the background well.

The five wells, 06-01A, 06-06, 06-07, 06-12, and 06C01P3, have screens set in the Pennsylvanian sands at depths ranging from 7 feet in 06-01A to 50 feet in well 06-06. The locations of the wells are shown on Plate 1 and in Figure 37. Well 06-01A was selected as the background well for this group because it was the most removed from the main cluster of apparently contaminated wells of the group and was relatively low in detected levels of evaluated metals.

A total of 19 observations were tabulated for the ANOVA tests. Well 06C01P3 was dry in the first round of sampling and had only 3 observations per metal. The other wells had four observations each. Because the number of observations was less than 50, the Shapiro-Wilks test was used to check for normality of distribution in the parametric ANOVA. All of the metals data failed the normality and variance tests and were subsequently analyzed using the non-parametric ANOVA. The central cluster of three wells, 06-06, 06-07 and 06-12 were statistically contaminated with various metals, with 06-07 showing contamination by more metals in higher amounts than the other two wells. Computer-generated printouts of the test data for each metal are presented in Appendix J.

Contaminating metals were **aluminum, arsenic, beryllium, cobalt, manganese, nickel,** and **zinc. Cadmium** and **chromium** were borderline. Detected amounts of the contaminating metals were much higher in the upper Pennsylvanian cluster of wells than in any other group of wells or aquifer in the Demolition Area/Old Rifle Range study area. Results of all non-parametric ANOVA tests, listed by metal, are summarized below.

Aluminum: Well 06-07 had significant evidence of contamination, with a rank difference of 10.50 vs. a critical difference of 8.82.

Antimony: No wells showed evidence of contamination.

Arsenic: Well 06-07 had significant evidence of contamination, with a rank difference of 9.50 vs. a critical difference of 8.82.

Barium: No wells showed evidence of contamination.

Beryllium: Well 06-07 had significant evidence of contamination, with a rank difference of 12.00 vs. a critical difference of 8.82.

Cadmium: No wells showed significant evidence of contamination, but well 06-07 could be considered borderline with a rank difference of 8.25 vs a critical difference of 8.82.

Chromium: No wells showed significant evidence of contamination, but well 06-07 had a rank difference of 7.88 compared to a critical difference of 8.82 and bears watching in future monitoring.

Cobalt: Wells 06-06 and 06-07 had significant evidence of contamination with rank differences of 11.25 and 14.75, resp. compared to the critical difference of 8.82. Well 06-12 had a rank difference of 7.00 of 8.82 and bears watching in future monitoring.

Copper: No wells showed evidence of contamination.

Lead: No wells showed evidence of contamination.

Manganese: Wells 06-06 and 06-12 had significant evidence of contamination with rank differences of 15.00 and 9.75, resp. vs. the 8.82 critical difference. Well 06-07 was borderline with a rank difference of 8.25 vs. 8.82.

Nickel: Wells 06-06 and 06-07 had significant evidence of contamination with rank differences of 11.25 and 14.75, resp. compared to the critical difference of 8.82. Well 06-12 had a rank difference of 7.00 vs. 8.82 and bears watching.

Vanadium: No wells showed evidence of contamination.

Zinc: Wells 06-06 and 06-07 had significant evidence of contamination with rank differences of 9.75 and 14.50 compared to the critical difference of 8.82.

Distribution of Contaminants

Parameters detected in the four rounds of sampling at the Demolition Area and Old Rifle Range are tabulated in Appendix E. The amounts detected and MCLs are also shown in the tabulation. Only those detected amounts above detection limit (no "J" values) are shown. The "VALUE_A" field is a data qualifier. A "B" for an organic compound indicates the analyte was found in the associated blank; a "B" for an inorganic compound indicates the reported value is less than the contract required detection limit but greater than the instrument detection limit.

Data evaluation methods

Several metals were detected at least occasionally in wells at the Demolition Area and Old Rifle Range. Explosives compounds were detected only in five wells at the Old Rifle Range, but persistently. Bar charts were prepared for nine selected metals for all wells and for detected explosives and

nitrates in the five Old Rifle Range wells. Bar charts permit a visual comparison of the levels of monitored parameters in different wells and groups of wells. This graphical presentation of metals values supplements the statistical analyses presented in the earlier section. Pertinent results from the statistical analyses are italicized in this section. The bar charts and accompanying well location maps are presented in Figures 29 through 73. Metals selected for comparison in all wells were copper, chromium, barium, manganese, nickel, antimony, lead, zinc, aluminum and arsenic. Detected amounts of beryllium, cadmium and vanadium and unusually high amounts of cobalt were reported for the group of shallow wells in the Demolition Area and were plotted for those wells only. The bar charts for metals compare detected quantities for four rounds of sampling for groups of four or five wells per chart. Three compounds (metals) are presented on each figure. Each chart displays the detection limit for the metal and the MCL, if exceeded. Wells in which a compound was not detected in any of the four rounds are labeled with ND (Not Detected) for that compound. If a compound was detected in at least one of the four rounds, a value of one-half the detection limit, rather than zero, was plotted for the remaining (not-detected) rounds for that compound. The use of one-half the detection limit is a conservative (safe-side) approach to contaminant evaluation, implying that, statistically, the undetected compound is likely to be present at levels below detection if it was detected during any other sampling event.

The reader can better appreciate the meaning of the statistical results, especially the significance of rank differences vs. critical differences, by visually comparing the bar charts for a particular metal in a particular well with the list of metals and wells determined to be "statistically significant" in the previous section. For example, the statistical analysis of arsenic in Big Clifty/Beech Creek wells indicated that 06C03 and 06C08 had significant evidence of contamination with arsenic. The bar charts for arsenic in these wells (Figure 36) showed graphically that 06C08 and 06C03 were indeed consistently positive for arsenic. The statistical analysis also indicated that 06C18 ranked close to the critical difference for arsenic and bears watching. The bar chart for 06C18 for arsenic (Figure 46), showed that the well had consistent levels of arsenic above DL, although the actual levels were less than the one-time and two-time occurrences in neighboring wells 06C10 and 06C11, neither of which had statistical evidence of arsenic contamination. The comparisons of the arsenic graphs of Figure 46 with the statistical results emphasizes the importance of *consistently* elevated levels in a well in establishing contamination status.

The distribution of metals in the study area is also shown by contour maps of <u>mean</u> concentrations of each contaminant over the four sampling rounds, for each aquifer. Nitrogen as nitrates and nitrites was also monitored in the fourth (final) round. Contour maps of concentration of nitrates and nitrites for the fourth round were also prepared. The contour maps were prepared using the inverse distance squared gridding algorithm, wherein the influence of a well value decreases as the inverse of the square of the distance to neighboring wells. Contaminant distribution maps prepared for detected parameters for four aquifers are provided as Appendix F. Selected maps are further presented in discussions of contaminant distribution in this section.

Table 14 presents the calculated mean values of mapped parameters (metals, nitrogen and explosives) over the four sampling rounds.

Metals

Demolition Area. Well 06C08 was originally selected to be the background well for the Demolition Area because it was situated north (outside) of the active operations area. Statistical analysis of metals in the Demolition Area/Old Rifle Range, presented earlier, subsequently indicated that 06C08 was actually contaminated with some metals and thus a poor background well. Well 06C07 was used as background for the statistical analyses. Comparisons of metals occurrences were made for two groups of wells, with well 06C08 common to both. The groups were: (1) 06C08, 06C07, 06C06, 06C05, and 06C04 and (2) 06C08, 06C12, 06C01, 06C02, and 06C03. All of the wells were Big Clifty-Beech Creek aquifer wells and were screened in the lower Big Clifty sandstone-Beech Creek limestone.

A third group of Demolition Area wells, 06-01A, 06-06, 06-07, 06-12 and 06C01P3, located in the northeast portion of the operations area, near the Navy E.O.D. area, and screening the upper Pennsylvanian sandstone, was evaluated for presence of metals (locations on Plate 1 and Figure 37).

Bar charts and a map for the first group of wells are presented in Figures 29 through 33. The first group of wells lies generally to the west and south of the operations area at the toe of the Demolition Area ridge, except for 06C08. Barium, copper and antimony were the most persistent metals detected in the group. Arsenic, aluminum and zinc were detected often in well 06C08 but only rarely in any of the other wells of the group. There was no apparent preference of all nine metals for any particular sampling round, nor was there an apparent trend (rise or fall over time). *Statistical analysis identified 06C08 as contaminated with aluminum and arsenic.* Bar charts and map for the second group of wells are presented in Figures 34 through 38. The second group lies generally to the northeast of the operations area at the foot of the slope, except wells 06C08 and 06C01. Barium, copper and antimony were again the most persistent metals detected. Arsenic was detected in concentrations near 0.01 mg/l (detection limit = 0.002 mg/l) in well 06C03, the only Demolition Area well other than 06C08 in which arsenic persisted. There was no apparent preference of all nine metals for any particular sampling round, nor was there an apparent trend. *Statistical analysis identified well 06C03 as contaminated with arsenic.*

The series of contour maps for the Lower Big Clifty/Beech Creek aquifer (Appendix F) indicate that nickel, zinc ,aluminum and nitrates and nitrites were prevalent in the northern half of the Demolition Area. Other metals were widely distributed.

Bar charts and map for the third group of wells are presented in Figures 39 through 45. The wells in this group, 06-01A, 06-06, 06-07, 06-12 and 06C01P3, are shallow wells screened in the upper Pennsylvanian sandstone of the Demolition Area. Wells 06-06, 06-07 and 06-12 of this group were the only wells in the Demolition Area/Old Rifle Range in which beryllium, cadmium and vanadium were found in more than one sampling round (except

that vanadium was found in 06C08 in two rounds). Additional bar charts were prepared for the three metals because there appeared to be a relationship between the metals' occurrence and the well locations.

Statistical ANOVA evaluation of the sampling data showed that wells 06-06, 06-07, and, to a lesser extent, well 06-12, had significant evidence of contamination, or were borderline, with several metals. The bar charts prepared for the well group provide graphic representation of the contaminant distribution. Well 06-07 had above-detection levels of all three metals in at least two sampling events. Cobalt was anomalously high in wells 06-06, 06-07 and 06-12. Figure 41 is a bar chart of cobalt values for the five wells of the group. Levels of cobalt ranged from 0.077 to 0.665 mg/l in the three central wells, but were never higher than 0.04 mg/l in any other well sampled for the Demolition Area/Old Rifle Range study. Wells 06-06, 06-07 and 06-12, especially 06-07, were unusually high in other metals as well.

Zinc was as high as 3 mg/l in 06-07 (Figure 44) and generally less than 0.08 mg/l in other Demolition Area/Old Rifle Range wells. Aluminum was exceedingly high in 06-07, up to 145 mg/l compared to not-detected to 0.2 mg/l in other wells (Figure 44). Arsenic, nickel, and antimony were comparatively high in the three wells, *but antimony was not shown by statistical analysis to be significantly high.* Nickel was as high as 2.0 mg/l in 06-07 (MCL for nickel is 0.1 mg/l). Manganese was statistically insignificant in 06C01P3 relative to the other four wells in this group, but was higher than levels in other Demolition Area wells that were significant. Manganese should probably be considered a contaminant in the group three wells. Iron and magnesium, which were not considered in the statistical analyses because they are not listed for primary MCLs, were anomalously high for wells 06-06 and 06-07 (iron) and 06-06, 06-07, 06-12, and 06-01A (magnesium), Figures 46 and 47. The high levels of metals in this group of shallow wells is strong indication of a local contaminant source at the surface or in the shallow subsurface in the vicinity of 06-06, 06-07 and 06-12. Additional probing should be done in the area to locate the source of the metals.

Investigations at other NSWCC SWMUs containing Pennsylvanian aged aquifers showed a correlation between low pH and relatively high levels of metals in the groundwater. Contour maps of mean pH and conductivity measured during four rounds of sampling were prepared for the upper Penn (third group) wells (Figure 48). Relatively low pH and high conductivity in the centrally located wells, especially 06-06, 06-07, and 06-12, correlated with relatively high levels of several metals including aluminum, beryllium, cadmium, chromium, cobalt, manganese, nickel, vanadium, and zinc. Mean groundwater conductivity in the three wells was much higher than in other Demolition Area/Old Rifle Range wells. Other Demolition Area/Old Rifle Range aquifers did not show a correlation between metals and pH/conductivity. Measured and mean values of pH and conductivity for all Demolition Area/Old Rifle Range wells were presented in Table 8.

The series of contour maps for the Demolition Area, Upper Penn Wells, Appendix F, emphasizes the concentration of certain metals near wells 06-06, 06-07 and 06-12, particularly zinc, aluminum, nickel, beryllium, and cadmium. Barium, common in most wells, was conspicuously absent in well

06-07, the well highest in the other metals including nickel, zinc and aluminum. See Table 14 for a tabulation of means.

Occurrence of the secondary MCL metals iron and magnesium in all wells was evaluated briefly because the metals comprise a portion of casings, warheads and drums treated at the Demolition Area/Old Rifle Range. Figures 46 and 47 present the mean levels over four sampling rounds of iron and magnesium, respectively, reported for all wells. Six wells were markedly higher in iron than the remaining wells, with mean values from 5.98 mg/l to 65.5 mg/l (06-07). Four of the wells were within the Demolition Area, including wells 06-06 and 06-07 of the third group of wells discussed two paragraphs above. The other two wells were 06C03, a Beech Creek well, and 06C08P2, a Pennsylvanian well (see Plate 1 for well cluster locations). Twelve wells were markedly higher in magnesium, with mean values from 31.0 mg/l to 392 mg/l (06-06). Seven of the wells were within the Demolition Area, including four wells of the third group of wells discussed above. Other Demolition Area wells high in magnesium were 06C01P3 (Pennsylvanian), 06C02P2 (upper Big Clifty/Beech Creek), and 06C04P2 (Golconda Haney).

Summary of Metals Occurrence in the Demolition Area. *Statistical analysis of metals in the lower (Big Clifty/Beech Creek) aquifer of the Demolition Area identified only aluminum, arsenic and manganese as significant contaminants.* Barium, copper and antimony persisted in four rounds of sampling in Big Clifty-Beech Creek wells monitoring the Demolition Area. The initially selected background well, 06C08, was actually as high or higher in several metals (nickel, antimony, copper, arsenic, aluminum and zinc) than the other wells. Conversely, 06C08 was one of few wells with relatively low levels of the otherwise ubiquitous compound, barium. Metals are persistent in monitoring wells at other SWMUs at NSWC. Certain metals are likely contaminants from the ordnance operations within NSWC, including Demolition Area activities, but may be present in the natural rocks and soils as well. Additional background evaluation for metals base-wide is needed.

The persistent metals barium, copper and antimony are concluded to be naturally occurring (background) components of the Big Clifty/Beech Creek aquifer or artifacts of rinsates and field blanks (copper and antimony occurred in the rinsate blanks at comparable levels). The metal antimony was detected at a level above MCL (0.01 mg/l) in all wells in the second sampling round (but is probably attributable to sampling artifacts). No other metals were detected at levels above MCL in Big Clifty-Beech Creek wells.

Occurrence of the metals vanadium, cadmium, and beryllium was limited to the shallow wells in the northeast portion of the Demolition Area operations area. Cadmium and beryllium were above MCL (0.005 mg/l for cadmium; 0.001 mg/l for beryllium) in well 06-07. The levels and the statistically significant occurrence of these metals and of zinc, nickel, aluminum, arsenic, manganese and cobalt in wells 06-06, 06-07 and 06-12, which are within 300 ft of each other, imply that the uppermost groundwater in that isolated area is being contaminated by a local source. Wells 06-01A and 06C01P3, which are 650 west and 350 ft east, respectively, of the group of wells, had essentially

no significant levels of the metals (with the possible exception of manganese in 06C01P3). Additional sampling of surface and shallow soils and continued monitoring of the wells will be necessary to confirm contamination and to delineate its source.

Iron and magnesium were markedly high in at least six Demolition Area wells.

Old Rifle Range. Well cluster 06C16 was selected as the common well for qualitative comparison of the Old Rifle Range wells. The cluster is located to the north and west of the Old Rifle Range open burning activities area. The deep well of the cluster, 06C16, screens the Beech Creek limestone and the lower part of the Big Clifty sandstone. The middle well, 06C16P2, screens the upper part of the Big Clifty sandstone (well 06C16P3 screens the Golconda/Haney limestone). Comparisons of monitored metals were made for two aquifer levels: the "lower zone" represented by the deep wells of each cluster, and the "upper zone" represented by the shallow wells of clusters and by the single wells emplaced for the 1981-83 confirmation study. The surface of the upper zone is the water table. Two groups of 5 or 6 wells each were compared for metals in the lower zone, using bar charts. Refer to Figure 4 for Old Rifle Range well locations. The wells were 06C16, 06C10, 06C11, 06C12 and 06C18 (charts in Figures 49 through 53), and 06C16, 06C15, 10C14, 06C17, 06C09 and 06C13 (charts 54 through 58). Three groups of 5 or 6 wells each were compared for metals in the upper zone. They were 06C16P2, 06C10P2, 06C11P2, 06C12P2 and 06C18P2 (charts 59 through 63), 06C16P2, 06C15P2, 06C14P2, 06-16 (shallow well for 06C17), 06-18 (shallow well for 06C09), and 06C13P2 (charts 64 through 68), and confirmation wells 06-17, 06-20, 06-22, 06-23, 06-19 and 06-14A (charts 69 through 73).

The first group of lower zone wells is in the southern portion of the Old Rifle Range (Figure 49). As in Demolition Area wells, barium, copper and antimony were the most persistent metals detected in the group. Chromium, nickel, arsenic and zinc were detected several times in some of the wells. Chromium and arsenic were detected several times in wells 06C10, 06C11 and 06C18, all located to the southeast and generally downgradient of the Old Rifle Range operations area. Chromium and arsenic were not detected in lower zone wells north or west of 06C13 (see Figure 54) and were not detected in the comparison well, 06C16.

The second group of lower zone wells is in the central and northern portion of the Old Rifle Range (Figure 54). Barium, copper and antimony were again persistent but nickel and zinc were also present in most of the wells in several sampling rounds. Nickel and zinc were higher in wells 06C17 and 06C09, respectively, than in any other Big Clifty/Beech Creek well. Chromium was not detected; arsenic was detected only once.

Contour maps of mean values of detected metals in the lower Big Clifty/Beech Creek aquifer of the Demolition area and Old Rifle Range (Appendix F) include the "lower zone" wells of the Old Rifle Range. The maps for chromium, arsenic, nickel and zinc emphasize the preference of the metals for certain regions within the Old Rifle Range. *The statistical analysis of metals in the Big Clifty/Beech aquifer identified only arsenic (borderline)*

and manganese as contaminants in Old Rifle Range "lower zone" wells, although well 06C17 was high for nickel.

The first group of upper zone wells is the upper equivalent of the lower zone wells in the southern portion of the Old Rifle Range (Figure 59). The distribution of metals in the upper zone wells is similar to that of the lower zone. Barium, copper and antimony persist. Chromium occurs in the southeast wells 06C10P2, 06C11P2 and 06C18P2, and arsenic in 06C10P2 and 06C18P2. Zinc is slightly more common in the upper wells than in the lower in the southern part of the Old Rifle Range.

The second group of upper zone wells is the upper equivalent of the lower zone wells in the central and northern portion of the Old Rifle Range (Figure 64). The distribution of metals in the upper zone wells is similar to that of the lower zone. Barium, copper and antimony persist but nickel and zinc were also detected often, as in the upper wells. Arsenic was noticeably present in 06C13P2 and 06C18P2, which are downgradient of the operations area. *Statistical analysis indicated that 06C18P2 and 06C13P2 (borderline) had evidence of arsenic contamination.*

The third group of upper zone wells consists of six confirmation wells that screen the Big Clifty sandstone or the alluvial soils of the Old Rifle Range. Included are the three monitoring wells closest to the flashing pits of the operations area: 06-20, 06-22 and 06-23 (see Figures 4 and 69). No unusual occurrences of the nine metals evaluated were evident in the six wells, with the possible exception of one-time high values of nickel detected in 06-20 and 06-23 and detectable levels in all four rounds in well 06-17 (Figure 71). Nickel was above its MCL of 0.1 mg/l in 06-20 and 06-23 in one sample event each. *However, the statistical ANOVA indicated that only 06-17, with consistently elevated levels, had significant evidence of nickel contamination.* The only comparable value of nickel detected in Old Rifle Range wells was a single occurrence of 0.112 mg/l in 06C17, a deep zone well southwest of the flashing pits. Again, barium, copper and antimony were common.

Maps of the calculated means of contaminant concentration for the uppermost aquifer at the Old Rifle Range were prepared and are exhibited in Appendix F. Tabulated means were presented in Table 14. The wells of the uppermost aquifer include the wells of the "upper zone" and the confirmation wells for which bar charts were prepared (the 06CXXP2 and 06-XX series of wells). The only apparent preferred distribution for metals was for nickel, aluminum, and lead, which were most common in the northern half of the Old Rifle Range, and arsenic, which was highest in the southeast quadrant near wells 06C13P2 and 06C18P2.

Occurrence of the secondary MCL metals iron and magnesium was evaluated because the metals comprise part of the materials treated at the Old Rifle Range. Figures 46 and 47 present the mean levels of iron and magnesium over four sampling rounds. Two Old Rifle Range wells, 06C13P2 and 06C18P2, located east of the operations area near Hiway 8 (Figure 4, locations 06C13 and 06C18), were markedly higher than other wells in iron, with mean values of 8.73 mg/l and 51.9 mg/l, resp. Wells 06C16P2 and 06C16P3 were markedly higher than other wells in magnesium, with mean values of 49.2 mg/l and 31.0 mg/l, resp. These four Old Rifle Range wells are the shallower wells of the respective clusters.

Summary of Metals Occurrence in the Old Rifle Range. *Statistical analysis identified only arsenic, nickel and manganese as significant contaminants in the uppermost aquifer at the Old Rifle Range.* Barium, copper and antimony persisted in four rounds of sampling in upper and lower alluvial, Big Clifty and Beech Creek wells monitoring the Old Rifle Range, but are considered background (naturally occurring) or artifacts of sampling rinsates or field blanks. Chromium and arsenic were detected several times in upper and lower zone wells in the southeast (downgradient) quadrant of the Old Rifle Range, and nickel in the upper zone wells of the northern half. Nickel was detected at relatively high values (> 0.1 mg/l, where MCL = 0.1 mg/l) one time in two shallow wells close to the flashing pits and consistently *and statistically* in 06-17, located about 200 ft north of the pits.

The metal antimony was detected at a level above MCL (0.01 mg/l) in most of the Old Rifle Range wells in many sampling rounds *(antimony was not statistically significant, however, when compared to background levels).* Nickel was detected at levels above its MCL of 0.1 mg/l in three wells on one occasion each (including the two shallow wells near the flashing pits). All other metals detected were below MCL.

The secondary MCL metals iron and magnesium were markedly higher in a few wells.

Metals in the Golconda/Haney aquifer. Positions of the four wells screened in the Golconda/Haney limestone aquifer are shown in Figure 74. The wells are 06C04P2, 06C03P2, 06-21 and 06C16P3. Bar charts of detected levels of the nine evaluated metals are presented in Figures 75 through 77. The levels of metals detected in the groundwater of the Golconda/Haney were noticeably less than in other aquifers of the study area. Barium, copper and antimony were most persistent but occurred at lower levels than in other aquifers. Nickel was detected twice in well 06-21, zinc once in 06C04P2, and arsenic once in 06C16P3. Chromium, lead and aluminum were not detected. Antimony was above MCL in six samples, but both copper and antimony were determined to be probable sampling artifacts.

Statistical analysis was not conducted for the Golconda/Haney because of the limited number of wells. Contour maps of calculated mean values of metals in the four Golconda/Haney wells are presented in Appendix F.

Wells 06-21 and 06C04P2 (Figure 74 and Plate 1) were markedly high in the secondary MCL metal magnesium (means of 84.8 mg/l and 48.7 mg/l, resp.).

Explosives and related compounds

Explosives. Eight explosives compounds were monitored for four rounds; nitrates and nitrites were monitored for the fourth round only. TNT, RDX and HMX were the only explosives detected in the Demolition Area/Old Rifle Range study area, and they were detected in only five wells, all within the northern half of the Old Rifle Range. Table 15 lists the detected values of explosives for each sampling round in the five wells. Seven of the 13 detection events for explosives were of "J" values (estimated values below detection limit). The only HMX detection was a "J" value in well 06C09.

Values of any explosives above detection limit were recorded only in wells 06-20 and 06-22, both shallow wells near the flashing pits.

A map and bar charts for detected explosives are presented in Figures 78 and 79. TNT occurred in well 06-22 in all four sampling rounds at levels above detection limit. The highest TNT value was 0.148 mg/l in the first round. Measured TNT levels decreased with each succeeding round (Figure 79). RDX occurred twice above detection in well 06-20. All other explosives recorded were below detection limit.

Contour maps of calculated mean values of TNT, HMX and RDX for the four rounds were prepared. The maps are presented in Appendix F with the metals maps and in Figures 80, 81 and 82. Wells plotted on the maps are all uppermost aquifer wells for the Old Rifle Range. The positions of the flashing pits are also shown on the maps. The maps illustrate the limited and preferred distribution of the three explosives in wells near the flashing pits. Calculated means are tabulated in Table 14. The highest levels of explosives were in the shallow wells 06-20 and 06-22 near the flashing pits. No explosives compound was detected more than once in deep wells (06C09 and 06C15) and then only at "J" levels. Explosives apparently are migrating from the source area through the aquifer very slowly if at all.

Nitrogen compounds. Nitrates commonly occur with explosives compounds as breakdown byproducts, and can serve as indicators for explosives contamination. For example, the explosive TNT reacts in the presence of oxygen (from ozone) and ultraviolet light to produce the following: $C_7H_5N_3O_6 + 18[O] \longrightarrow 7CO_2 + H_2O + 3NO_3^- + 3H^+$ (ICF Kaiser). Nitrates are sometimes attributable to agricultural activities (runoff or infiltration of fertilizers), but the study area has no history of such use. Also, there is an apparent correspondence of high nitrate wells to explosives-contaminated wells at the Old Rifle Range. Nitrates were detected in 33 Demolition Area/Old Rifle Range wells in the fourth round, the only round in which nitrates were monitored. Nitrates were anomalously high, however, in four of the five Old Rifle Range wells in which explosives compounds were detected. Figure 83 is a bar chart of nitrate levels for the five wells evaluated for explosives. The nitrate levels in wells 06C09, 06-20, 06-22 and 06-18 were all greater than 3 mg/l. The level in 06-20 was 18.2 mg/l. MCL for nitrates is 10 mg/l. Nitrate levels detected in all other Demolition Area/Old Rifle Range wells were less than 1 mg/l. There was no relationship shown for nitrites.

A contour map of detected values of nitrates in the uppermost aquifer wells at the Old Rifle Range is presented in Appendix F and in Figure 84. Nitrates were detected in all but two of the wells shown, but only levels greater than 3 mg/l were contoured. Detected levels of nitrates are tabulated in Table 14. The concentration of high levels of nitrates near the flashing pits is similar to that of TNT, HMX and RDX and supports the assertion that nitrates and explosives are related in occurrence.

Contour maps of nitrates and nitrites concentrations in the Golconda/Haney wells are presented in Appendix F.

Summary of contaminant distribution

Statistical analysis of metals detected in four rounds of sampling in Demolition Area and Old Rifle Range monitoring wells provided evidence of contamination in some wells by the following metals: aluminum, arsenic, beryllium, cobalt, manganese, nickel and zinc at the Demolition Area and arsenic, manganese and nickel at the Old Rifle Range. The following metals were considered borderline contaminants, i.e., their statistical values were just below tabulated critical values: cadmium and chromium at the Demolition Area and zinc at the Old Rifle Range.

Non-statistical evaluation of explosives and nitrates indicated contamination of a centrally located group of Old Rifle Range wells by TNT, RDX and nitrates.

Contamination is limited to specific wells or groups of wells. Two maps are provided to show the location and distribution of the named contaminants. Figure 85 shows the distribution of contaminants in Demolition Area wells. Figure 86 shows the distribution of contaminants in Old Rifle Range wells.

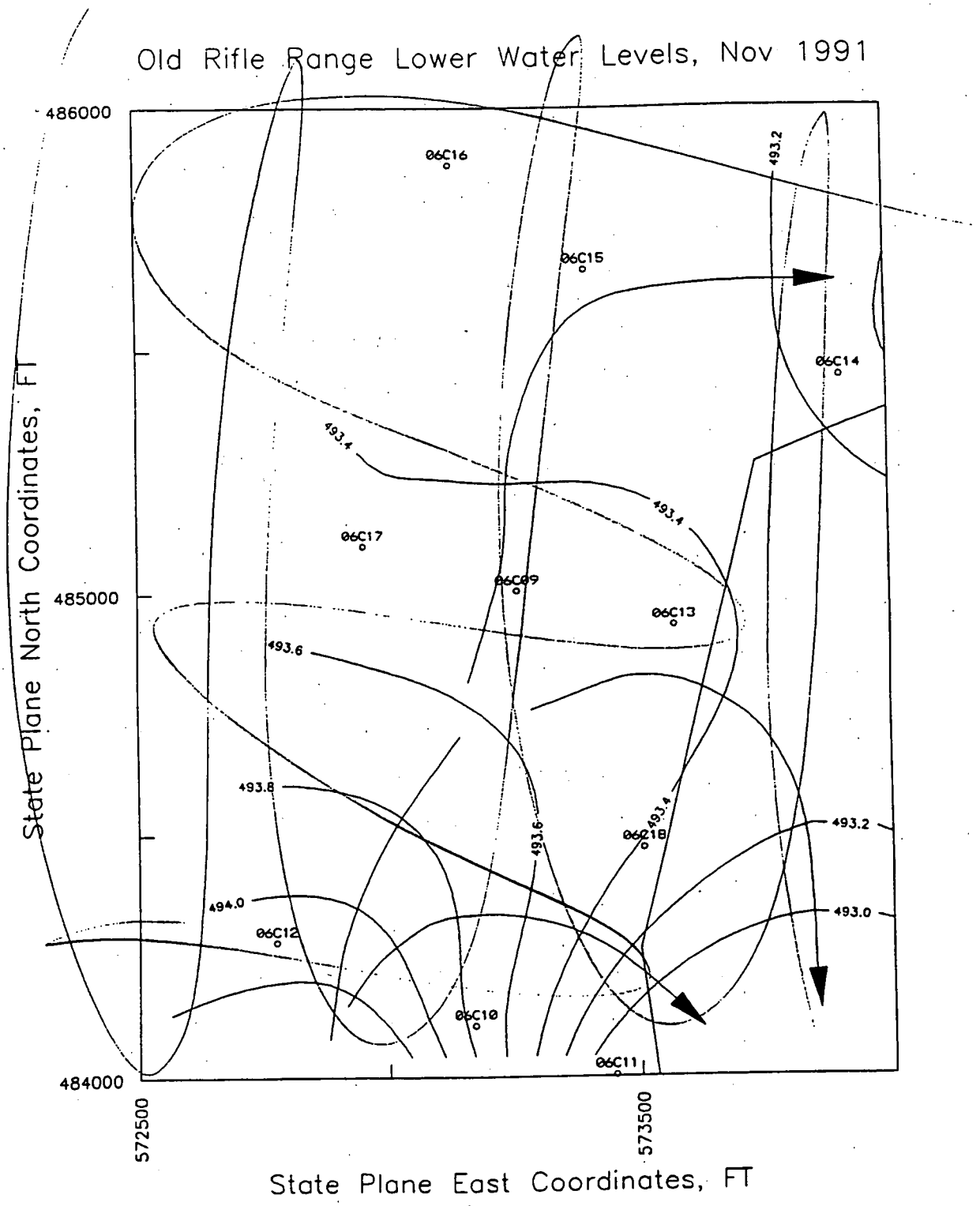


Figure ~~26~~ 28. Piezometric surface for Nov, 1991, Big Clifty-Beech Creek aquifer, lower zone, Old Rifle Range.

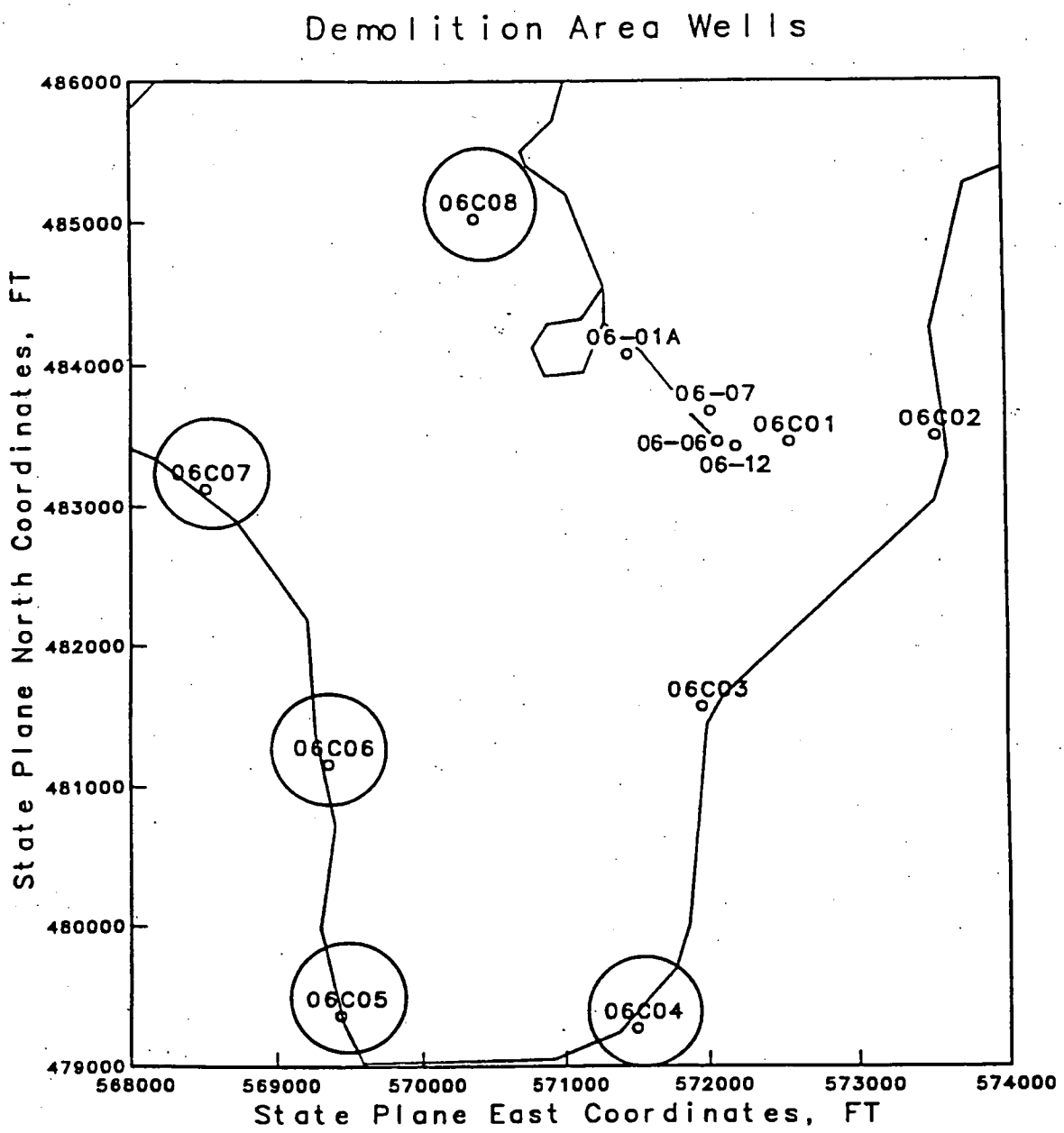


Figure 29. First group of Demolition Area wells (for metals).

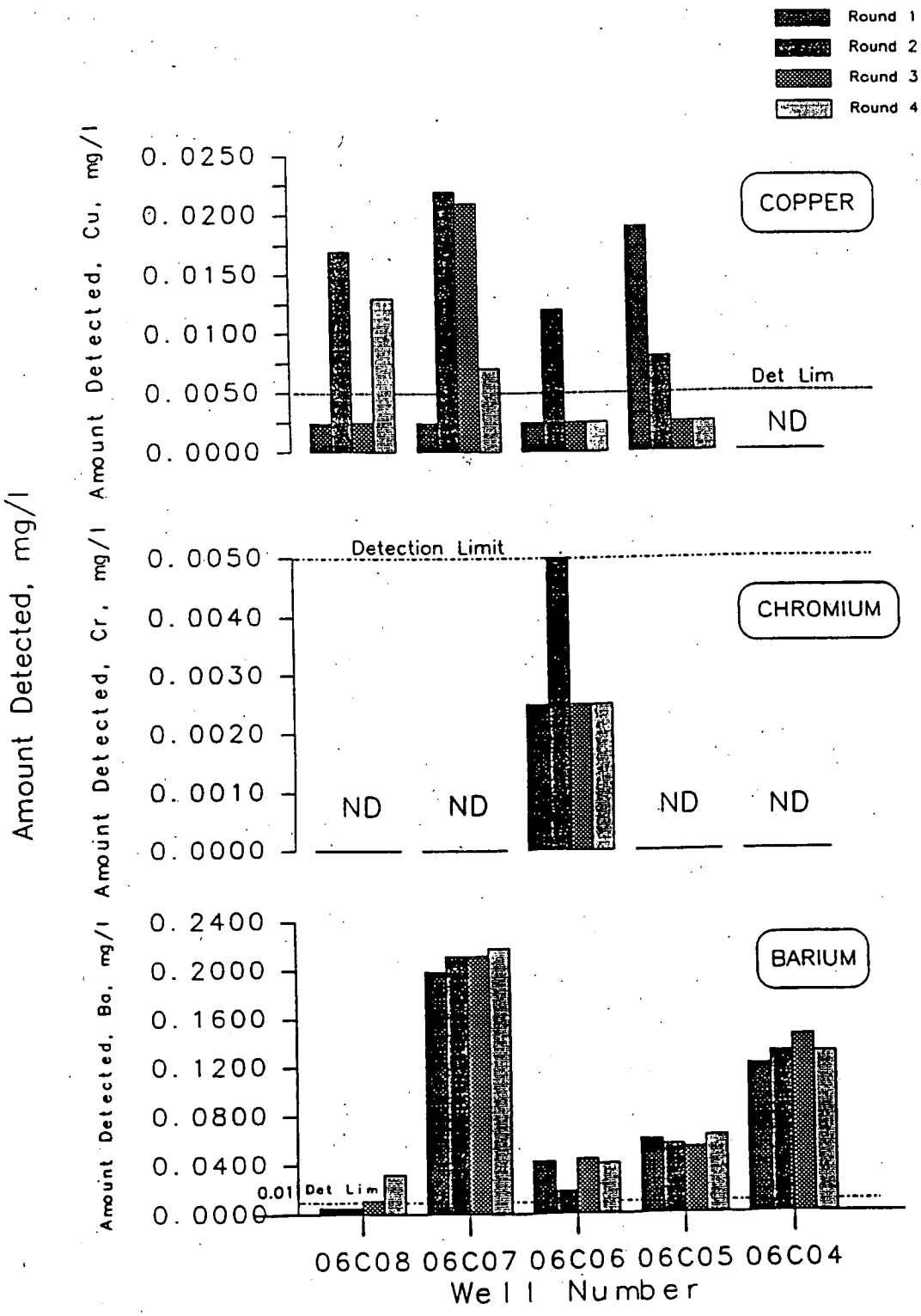


Figure ~~28~~ 20. Levels of copper, chromium and barium detected in Demolition Area first group wells.

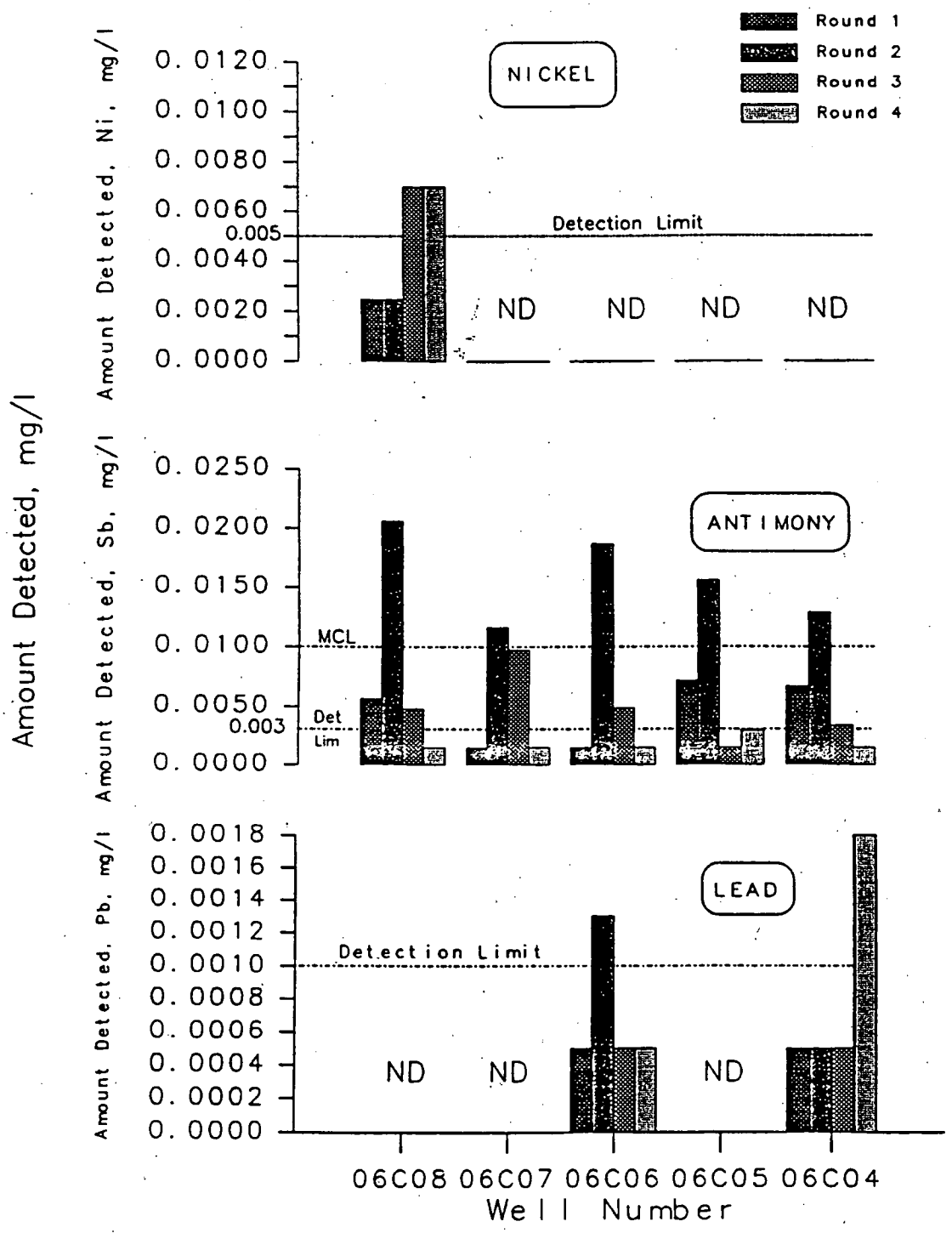


Figure ~~29~~ 31. Levels of nickel, antimony and lead detected in Demolition Area first group wells.

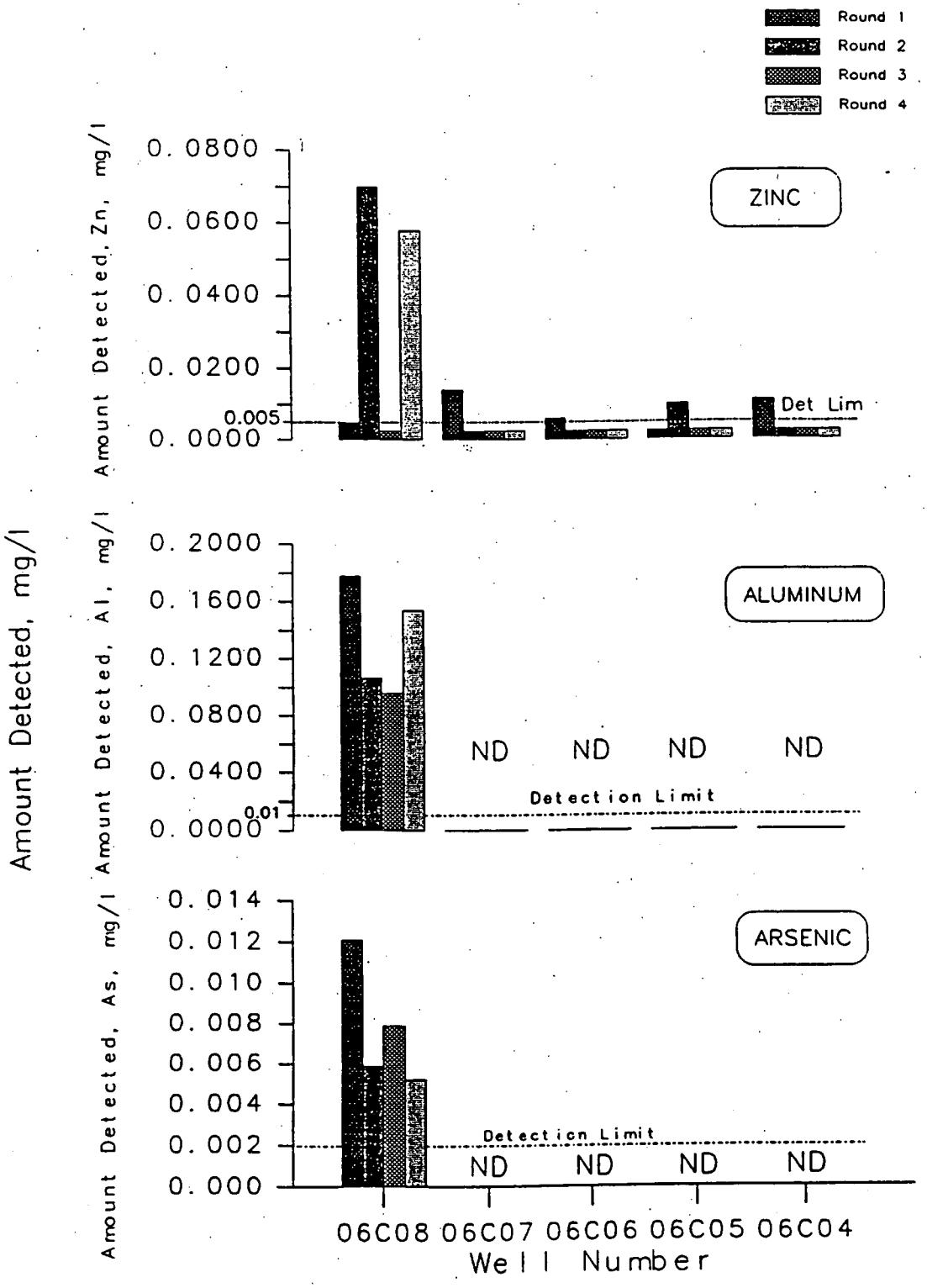


Figure ~~30~~ 32. Levels of zinc, aluminum and arsenic detected in Demolition Area first group wells.

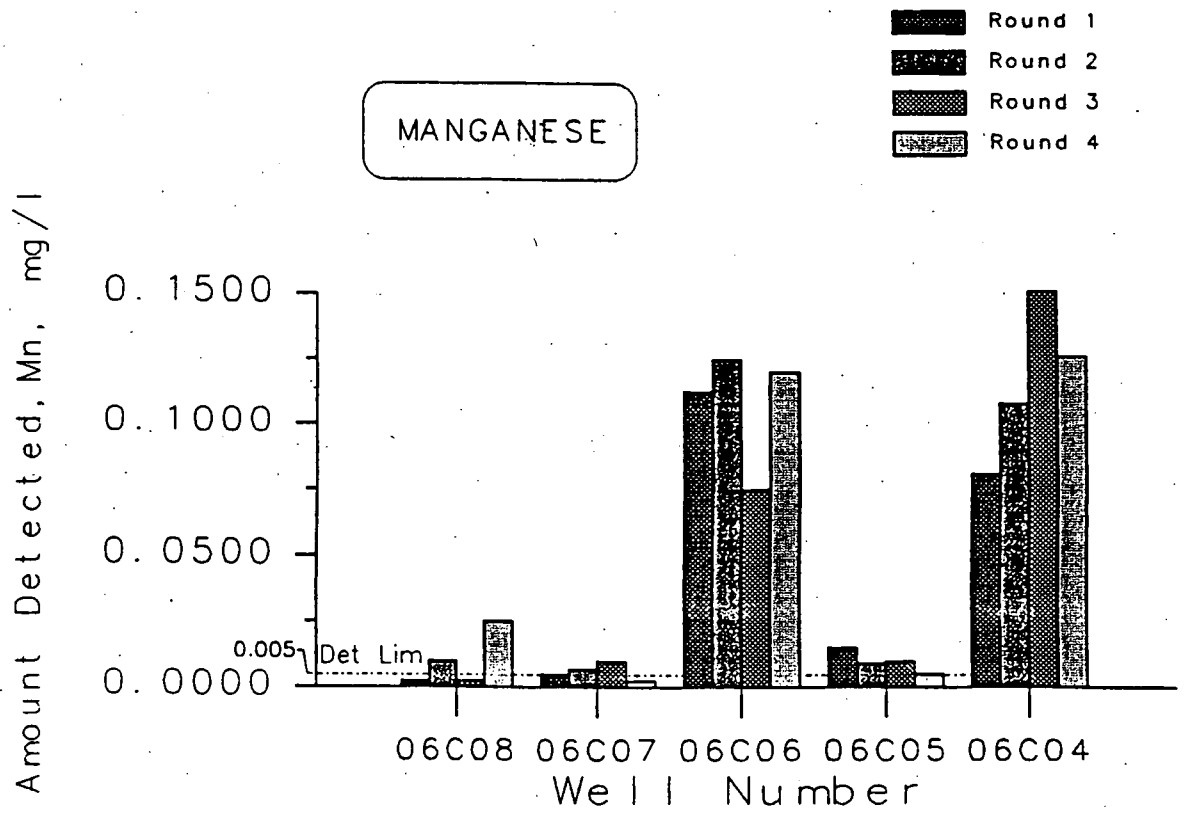


Figure ~~30A~~ 33. Levels of manganese detected in Demolition Area first group wells.

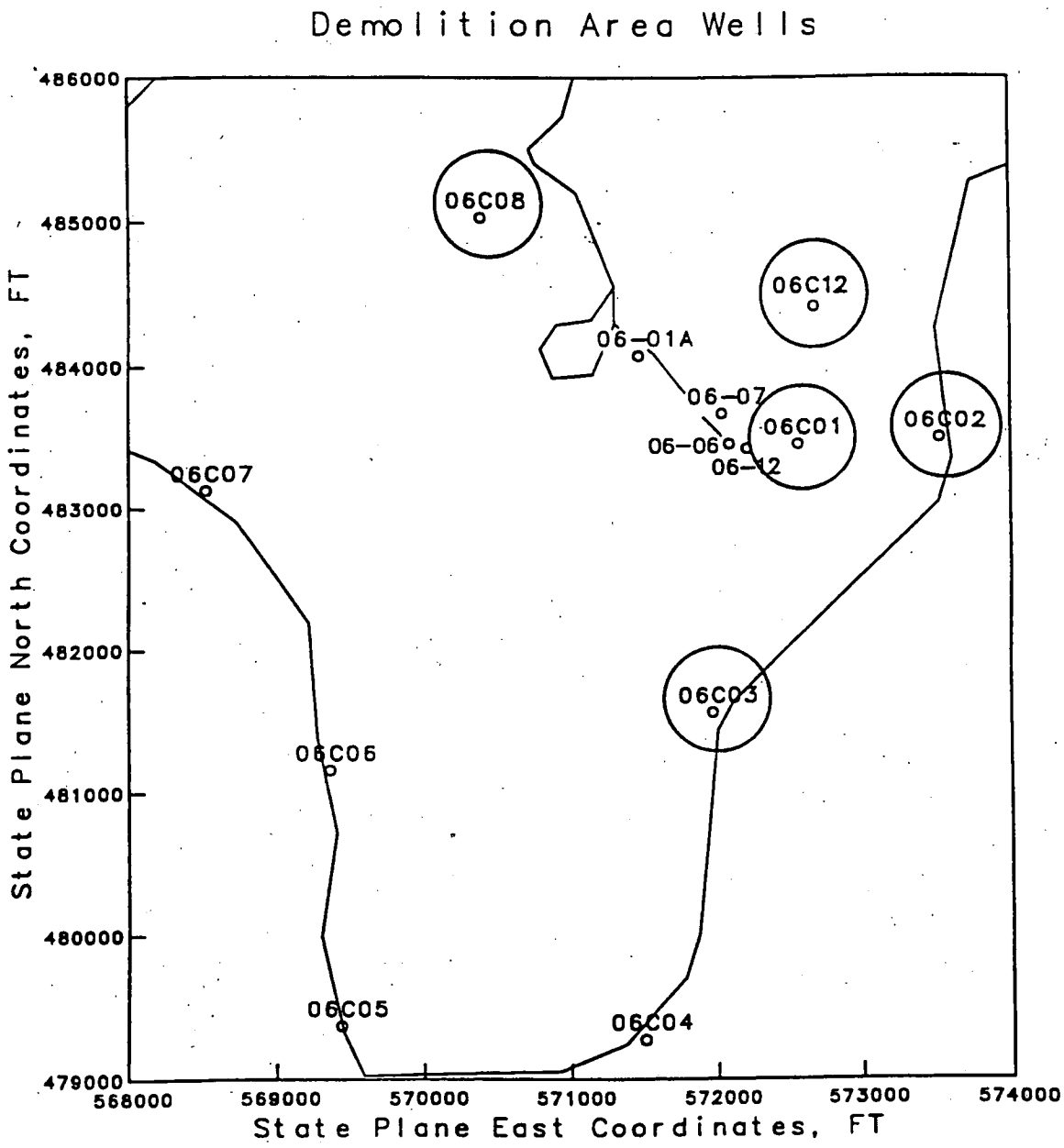


Figure ~~31~~ 3A. Second group of Demolition Area wells (for metals).

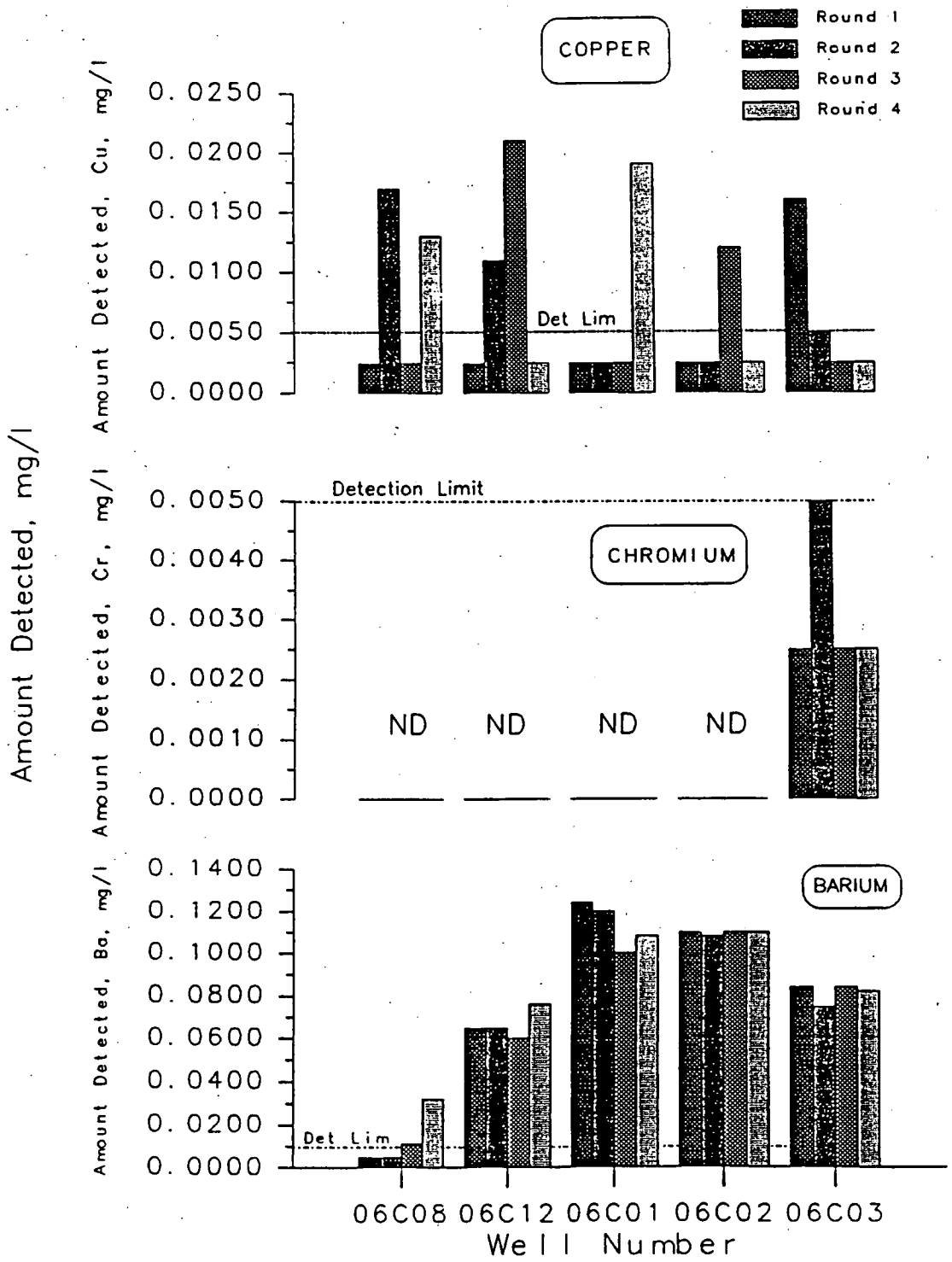


Figure 32. Levels of copper, chromium and barium in Demolition Area second group wells.

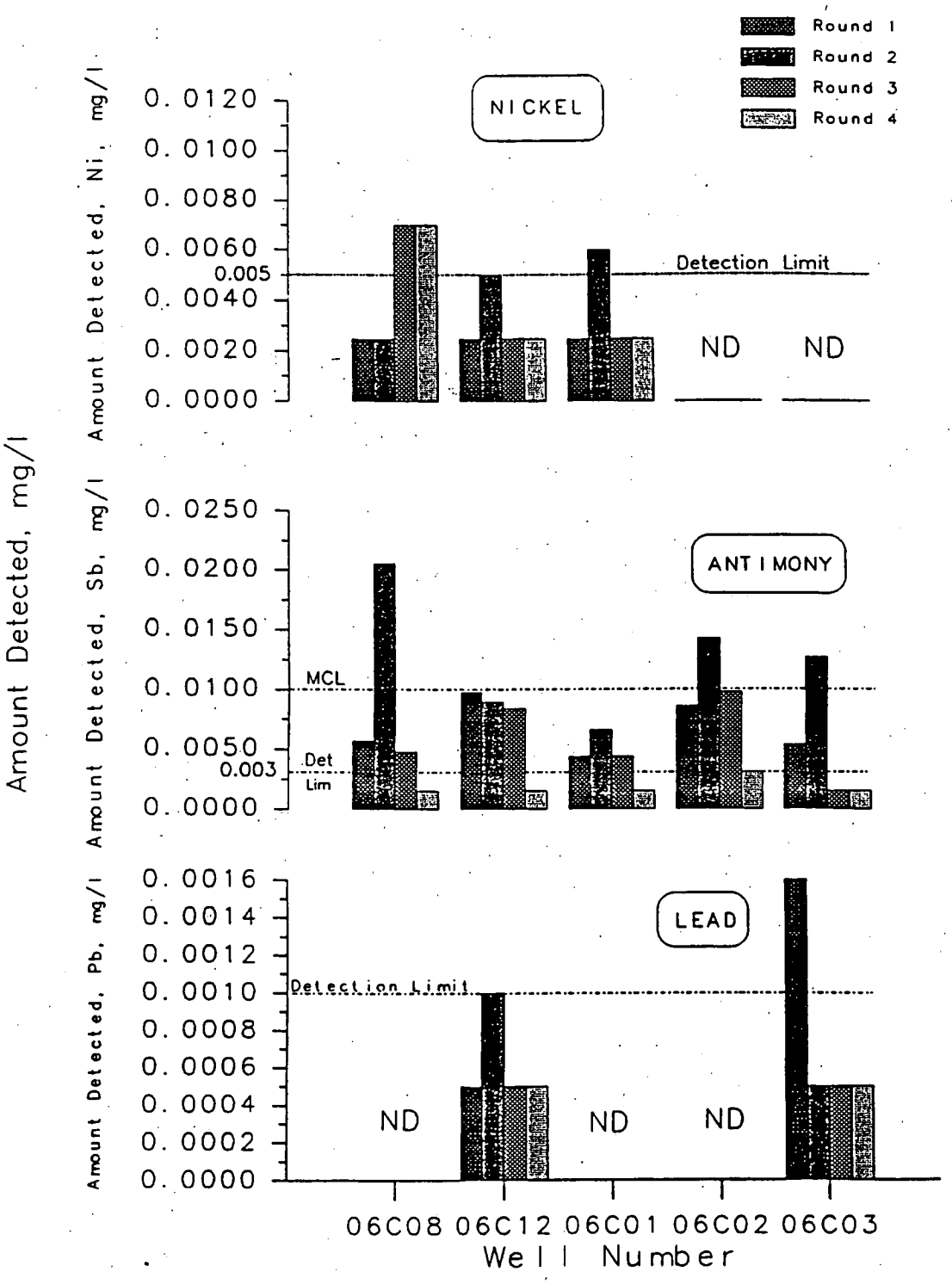


Figure ~~33~~ 34. Levels of nickel, antimony and lead in Demolition Area second group wells.

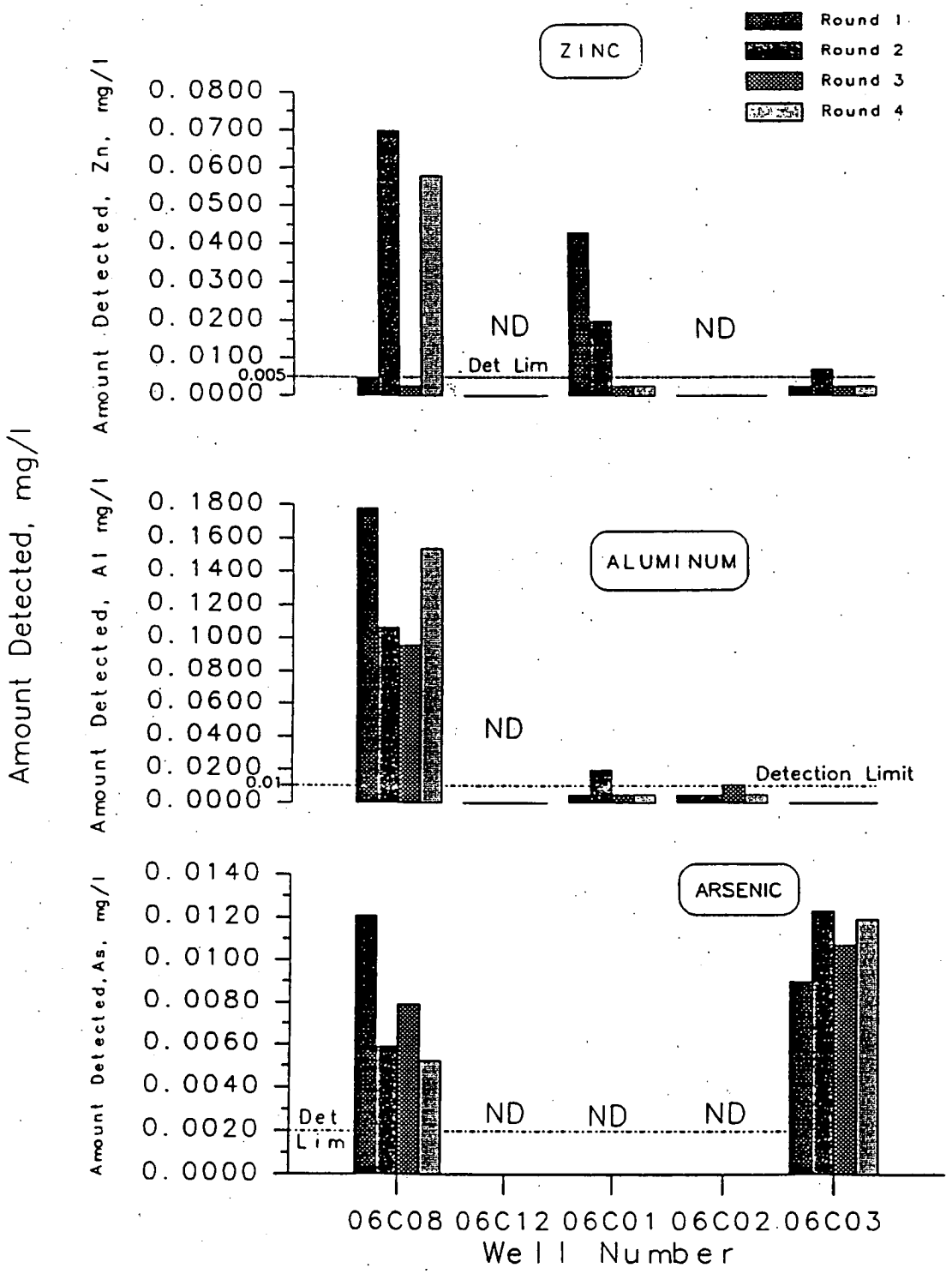


Figure 34. Levels of zinc, aluminum and arsenic in Demolition Area second group wells.

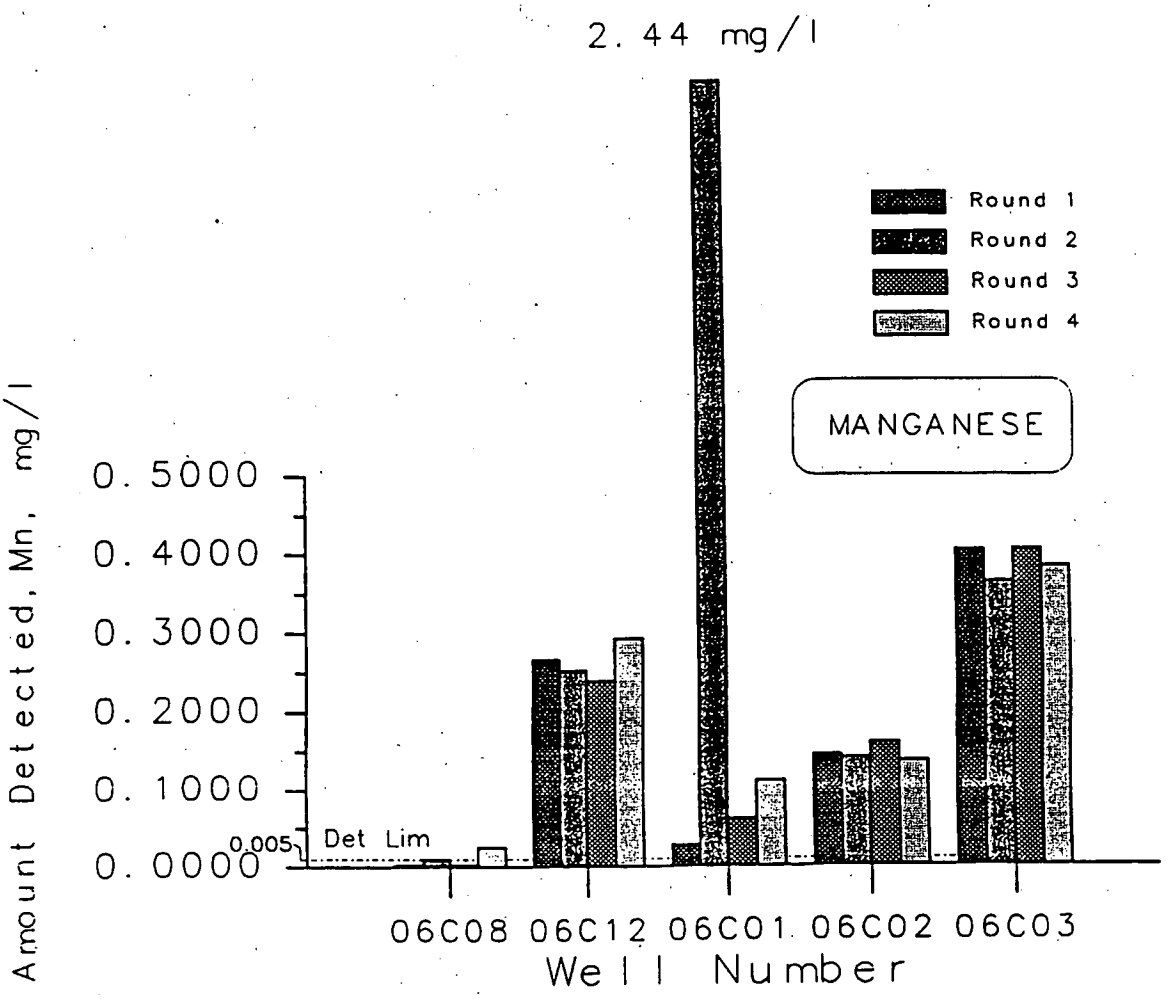


Figure ~~34A.~~ 38 Levels of manganese detected in Demolition Area second group wells.

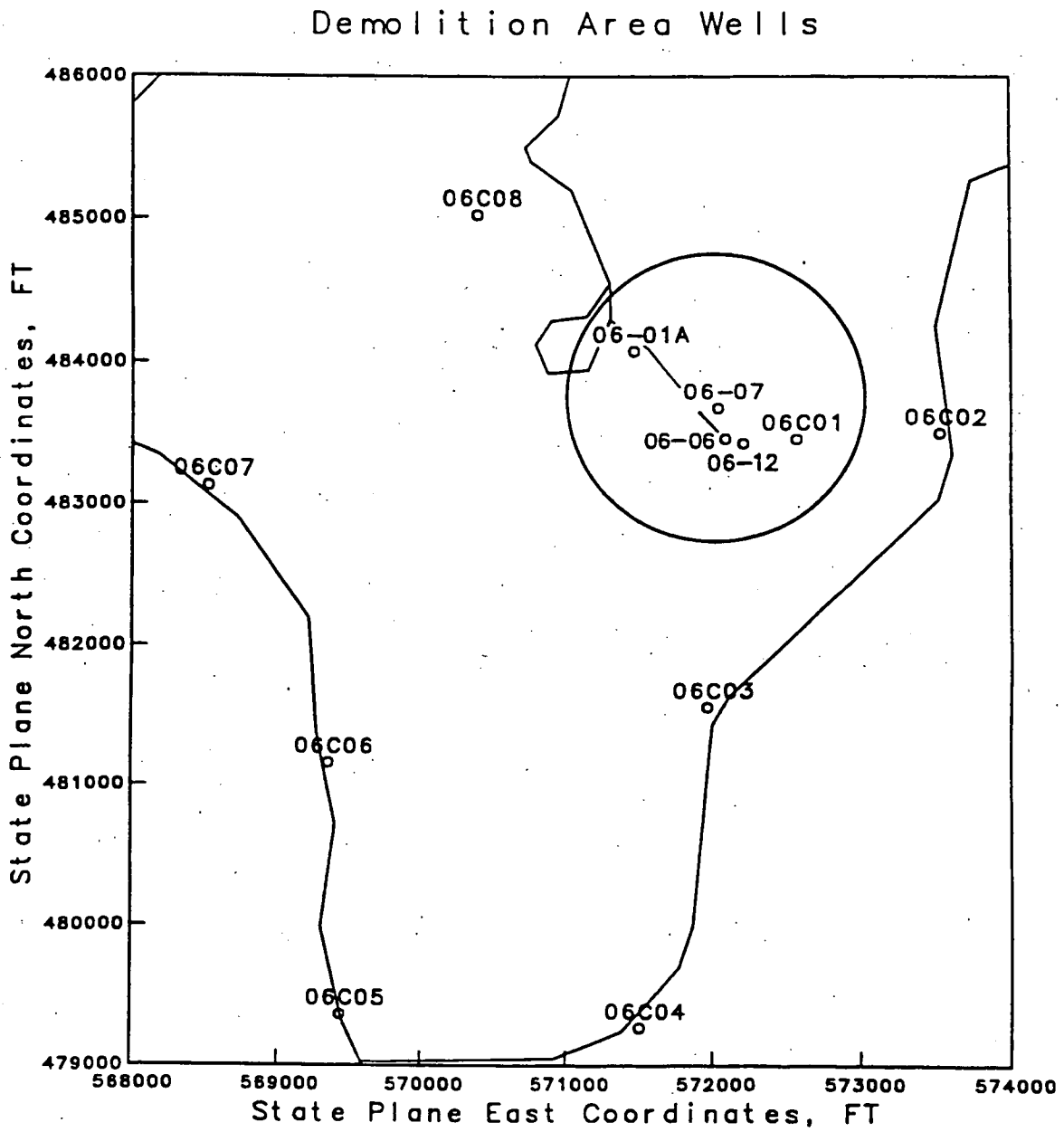


Figure 35. Third group of Demolition Area wells (for metals).

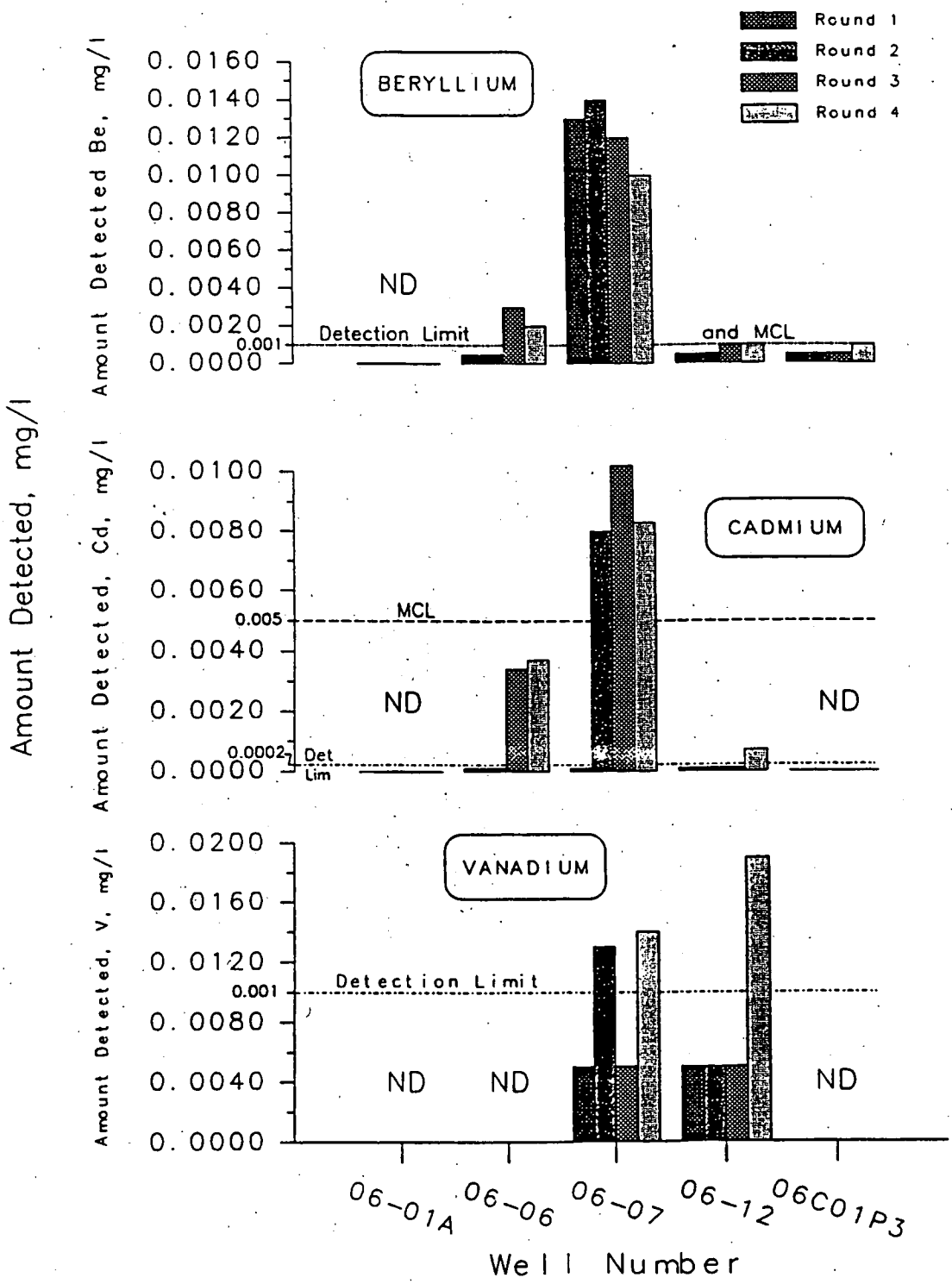


Figure ~~36~~ 40. Levels of beryllium, cadmium and vanadium in Demolition Area third group wells.

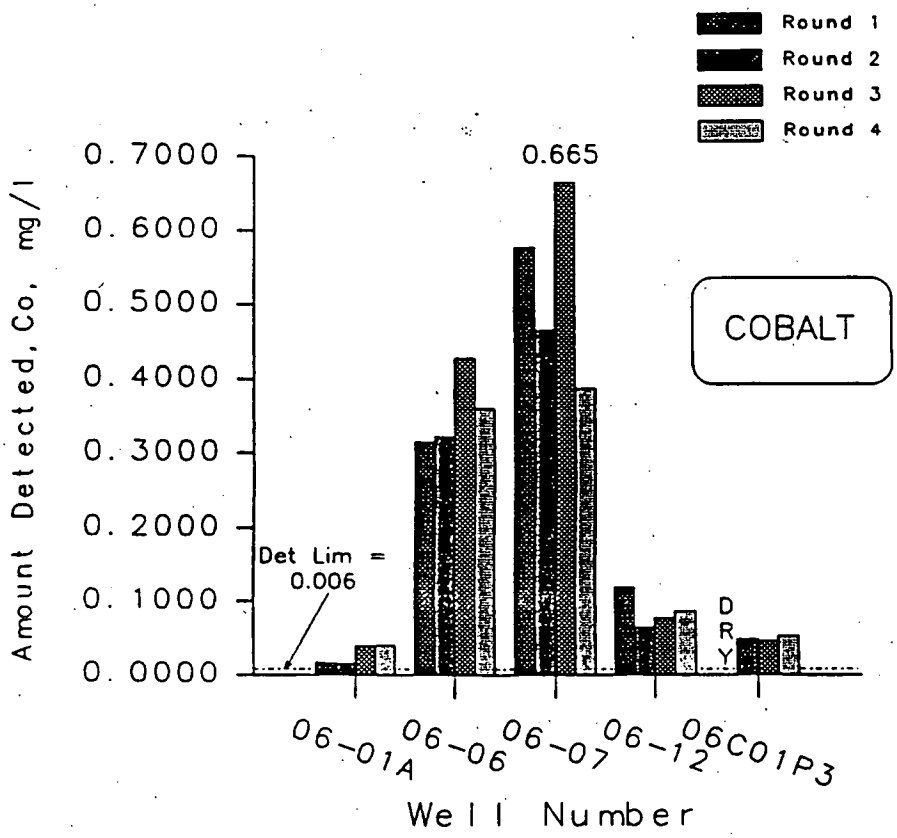


Figure ~~37~~ 41. Levels of cobalt in Demolition Area third group wells.

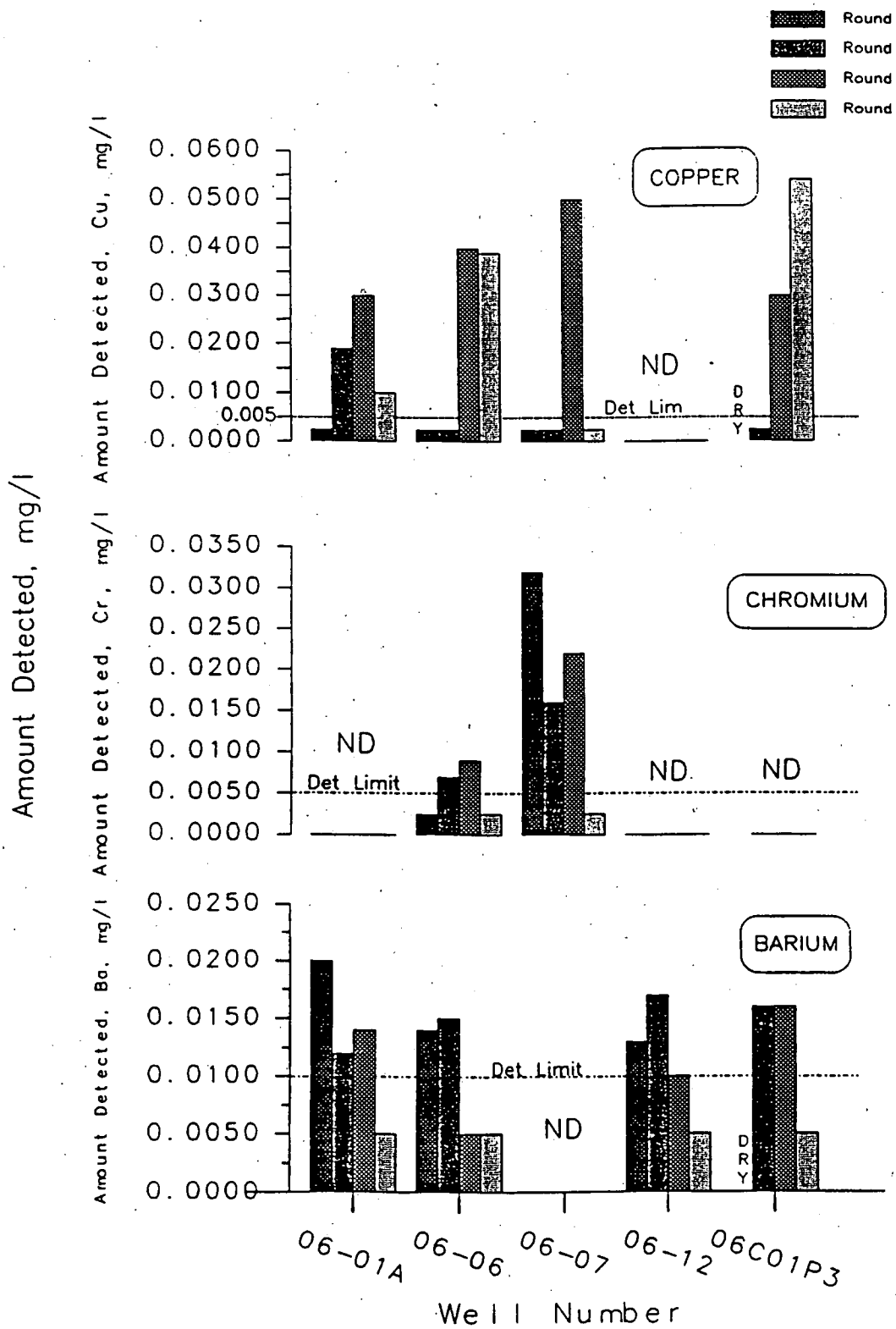


Figure ~~38~~ 42. Levels of copper, chromium and barium in Demolition Area third group wells.

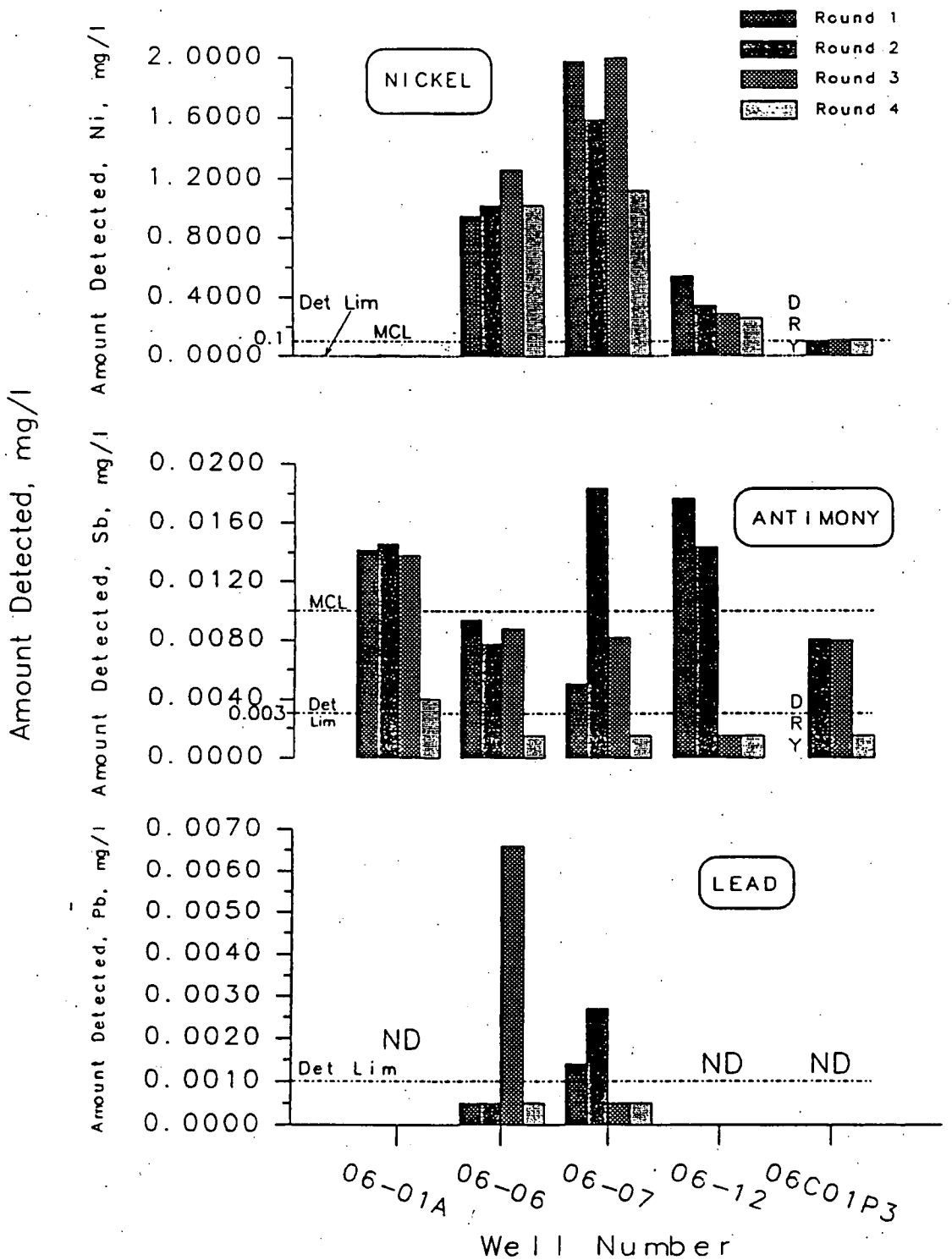


Figure ~~39~~ 43. Levels of nickel, antimony and lead in Demolition Area third group wells.

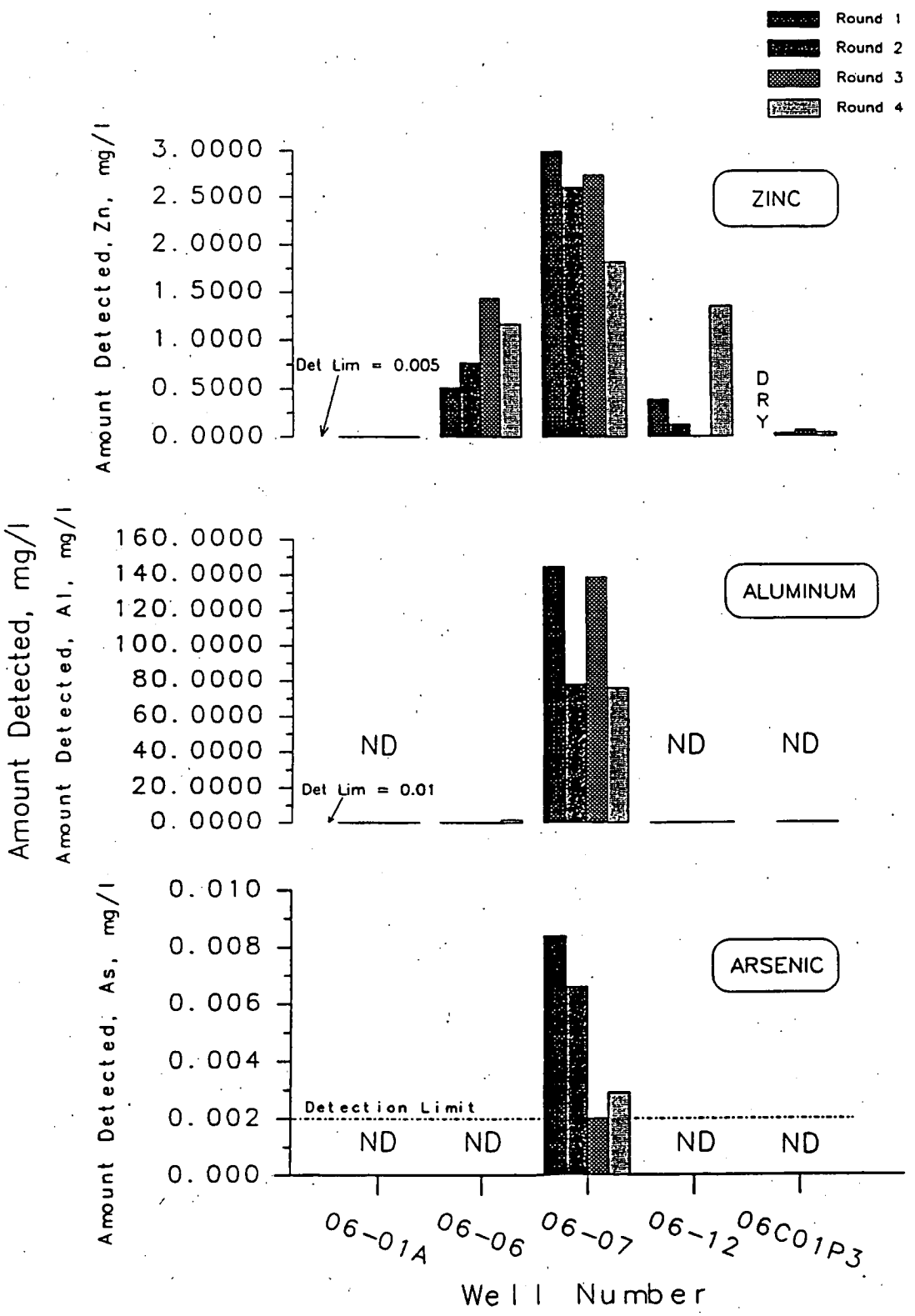


Figure ~~40~~ 44. Levels of zinc, aluminum and arsenic in Demolition Area third group wells.

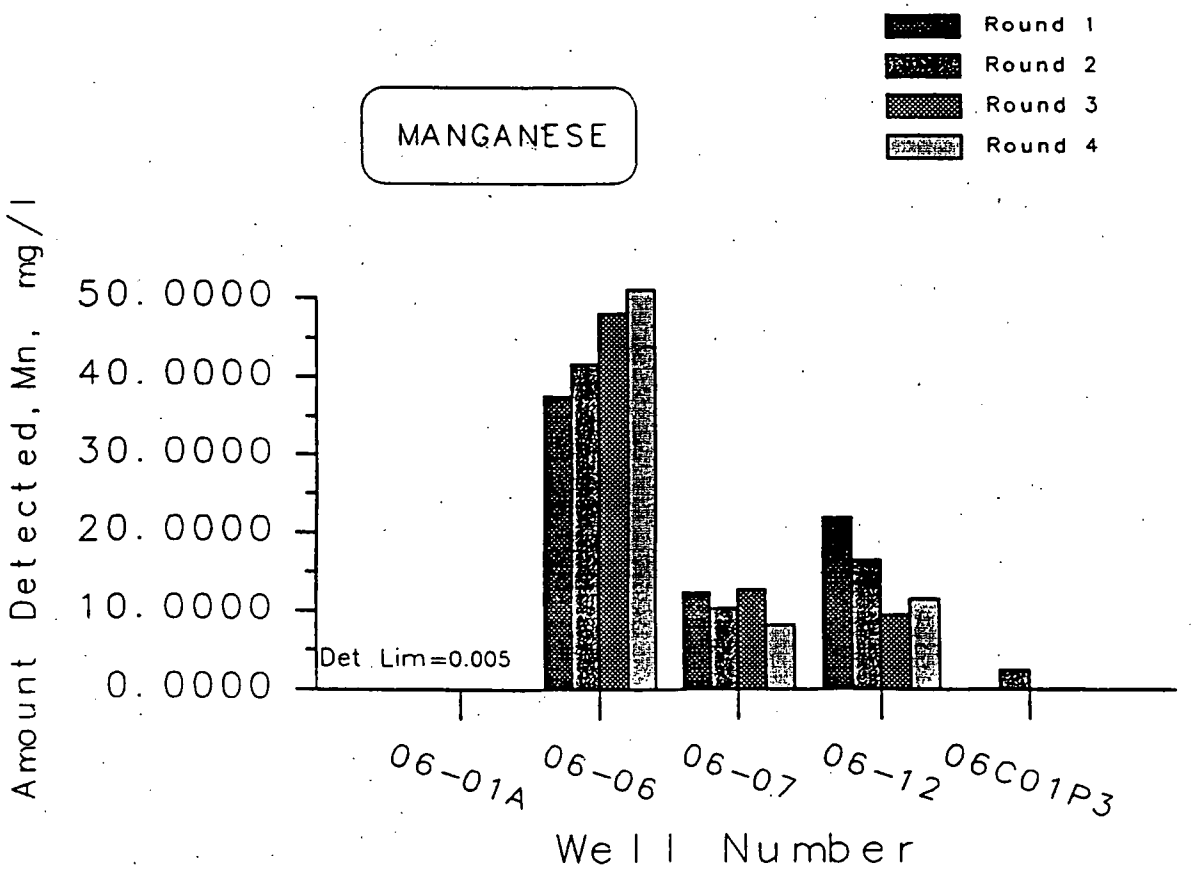


Figure ~~40~~ 45A. Levels of manganese detected in Demolition Area third group wells.

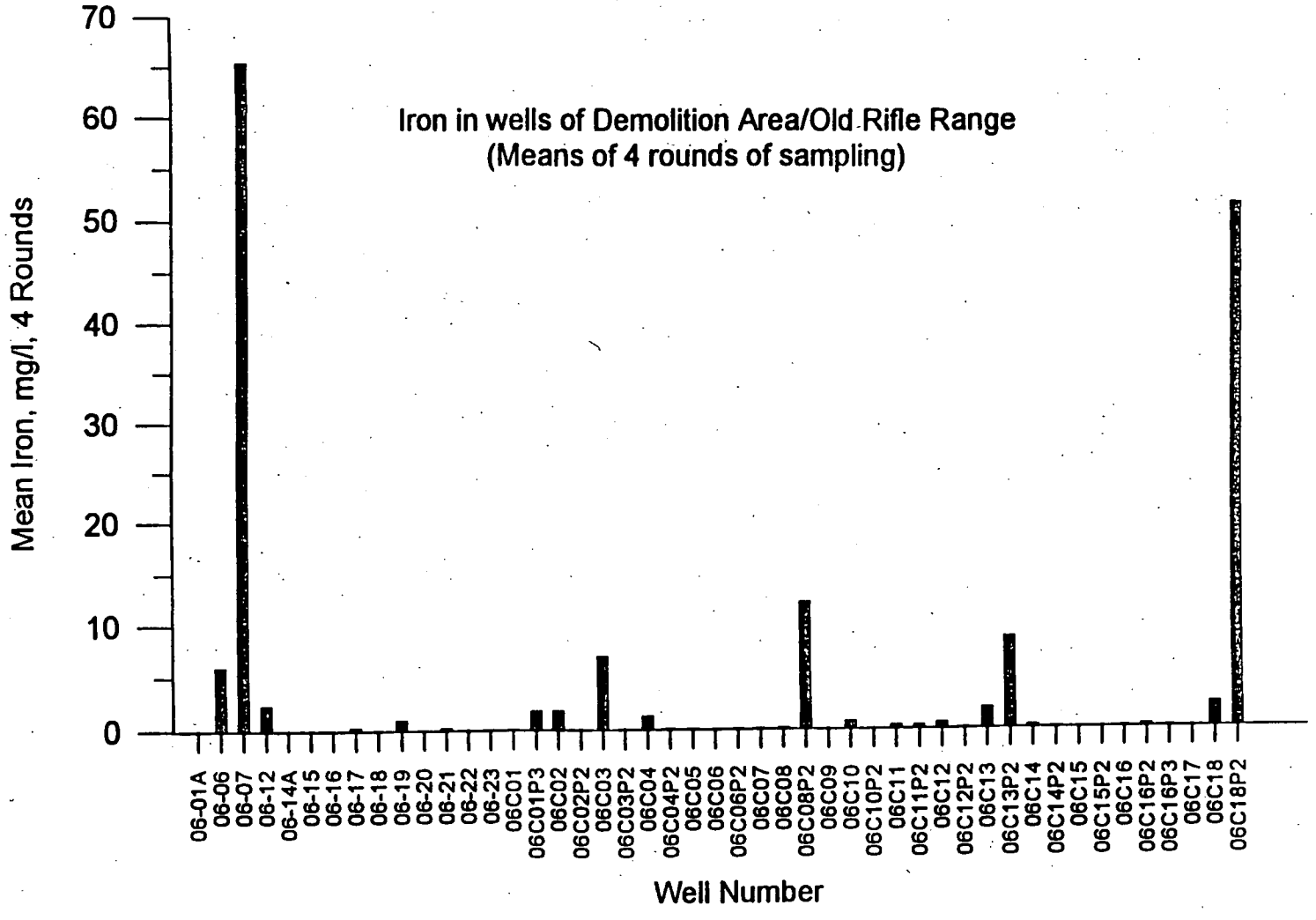


Figure ~~40B~~ 4C. Mean levels of iron for four rounds of sampling, all wells, Demolition Area/Old Rifle Range.

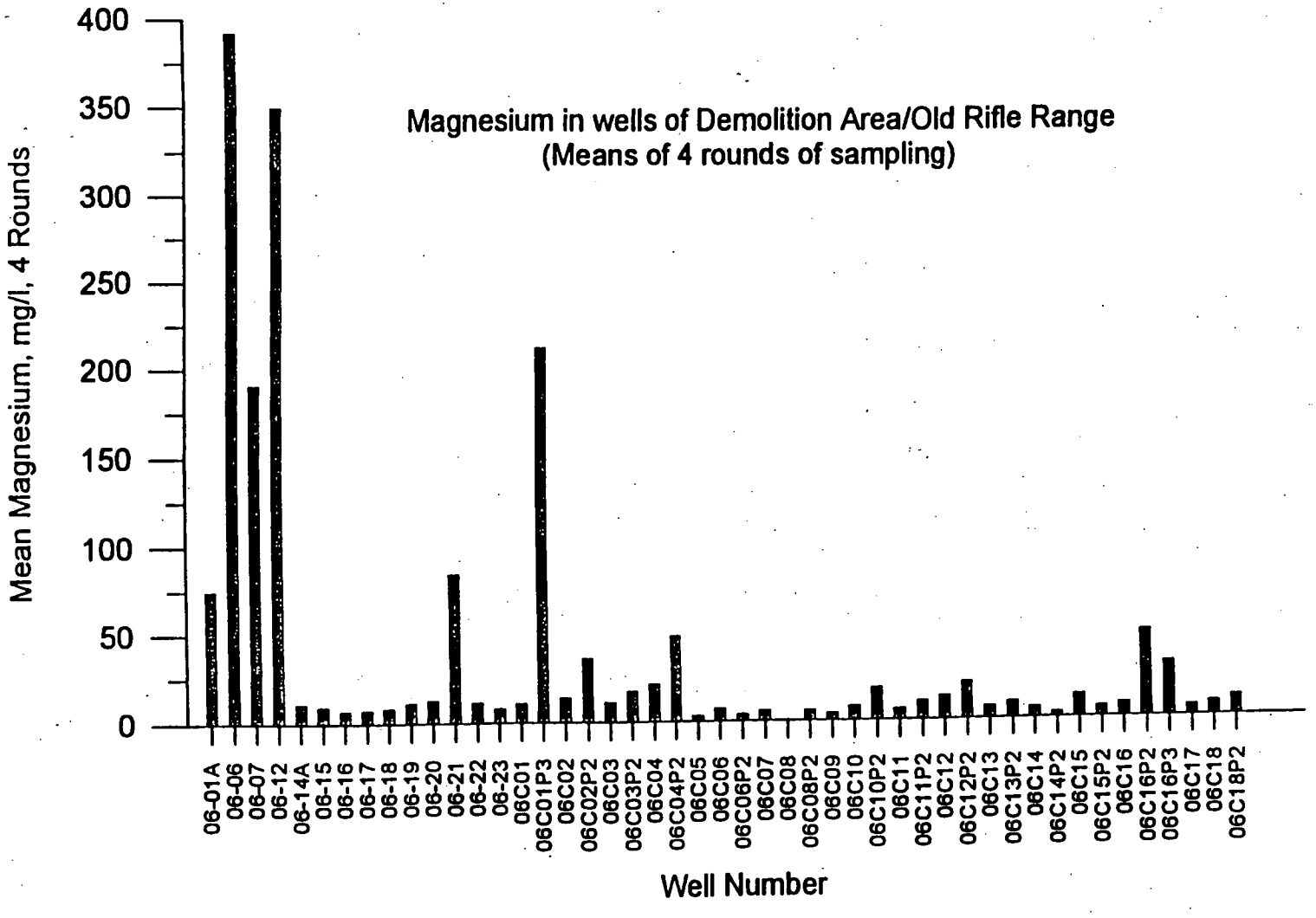
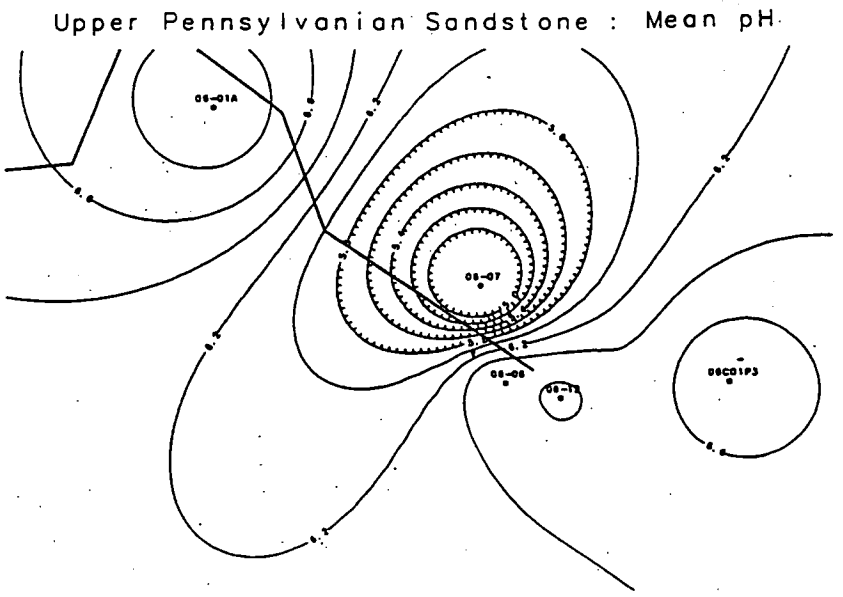


Figure ~~A~~97C. Mean levels of magnesium for four rounds of sampling, all wells, Demolition Area/Old Rifle Range.



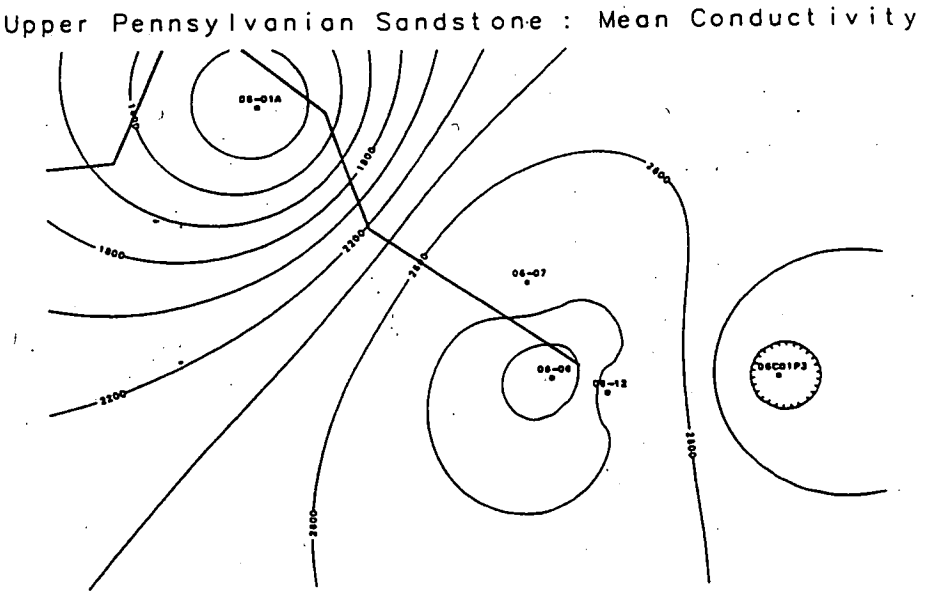


Figure ~~40D~~ A9. Mean field-determined pH and conductivity in four rounds of sampling, third group wells, Demolition Area.

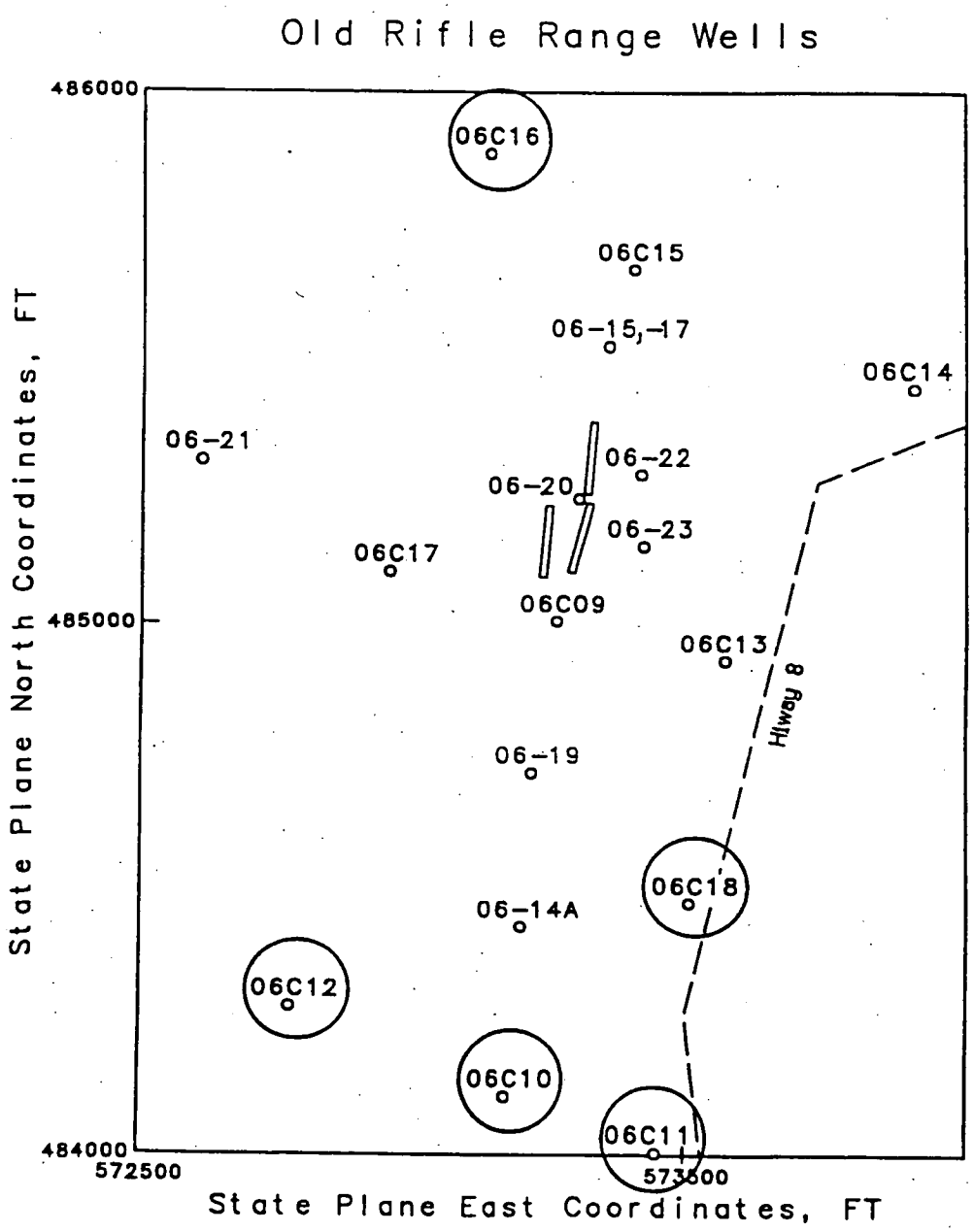


Figure ~~41~~ 49. First group of lower zone wells, Old Rifle Range.

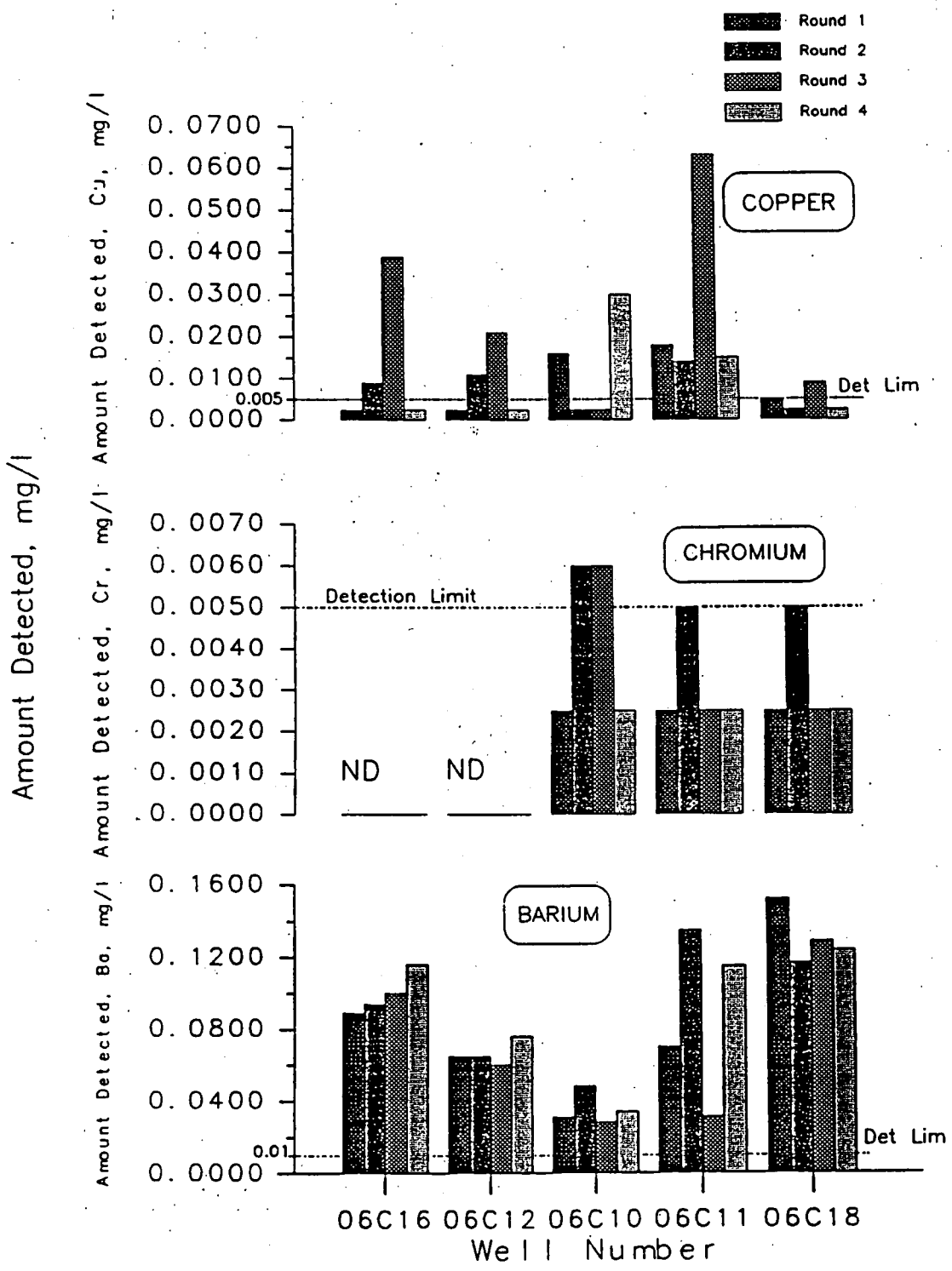


Figure 42. Levels of copper, chromium and barium in first group of lower zone wells, Old Rifle Range.

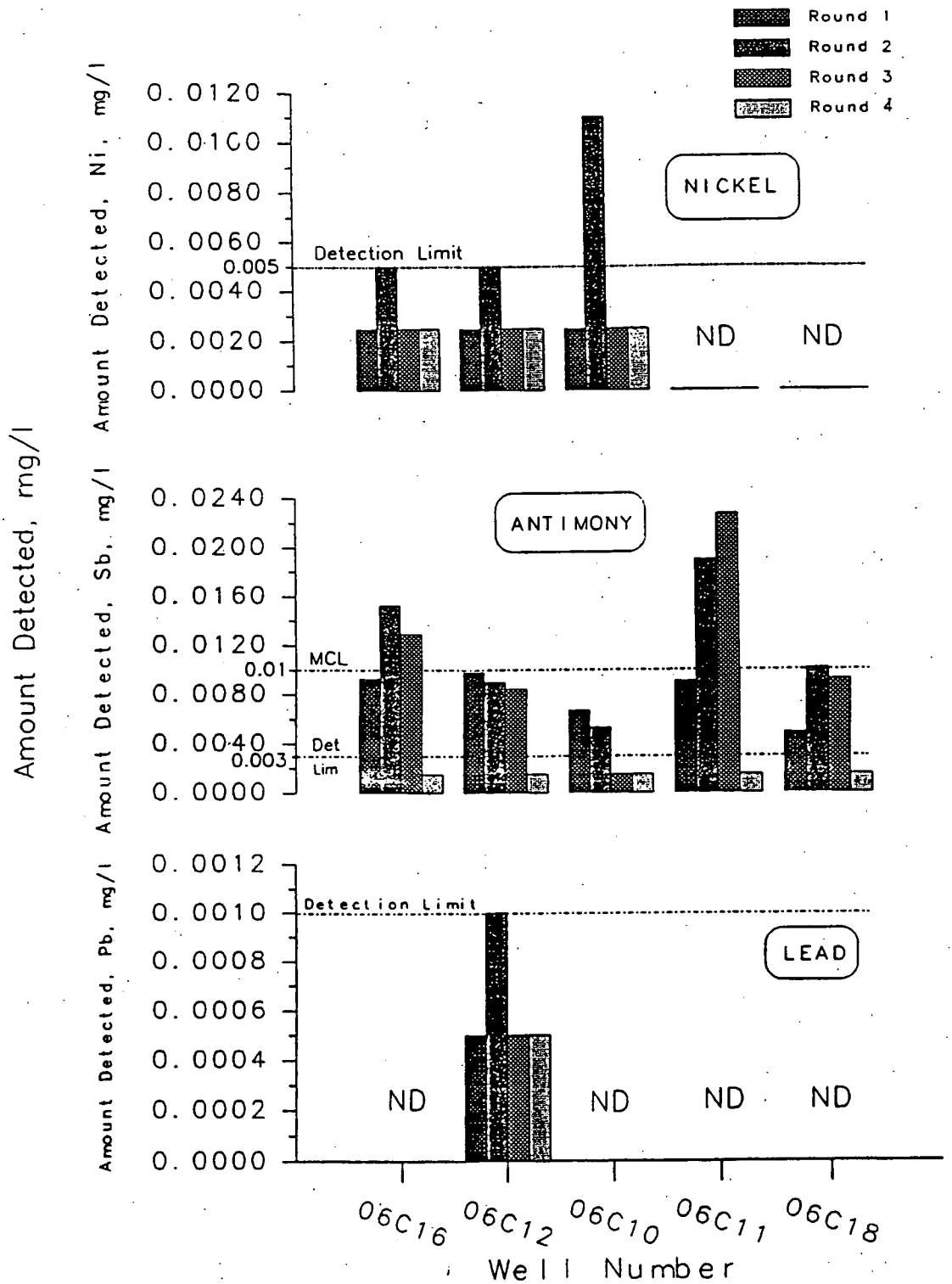


Figure 51. Levels of nickel, antimony and lead in first group of lower zone wells, Old Rifle Range.

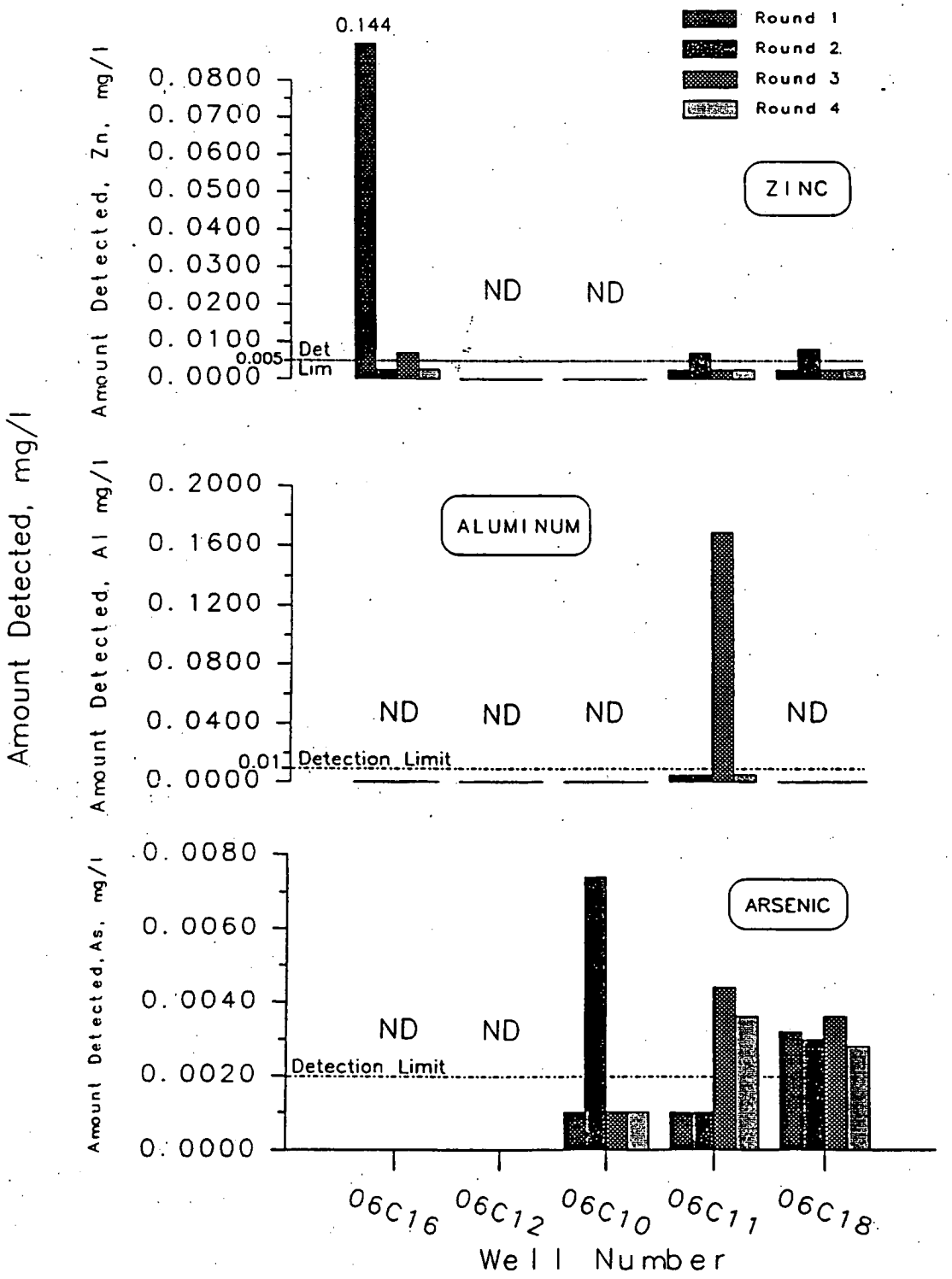


Figure ~~44~~ 52. Levels of zinc, aluminum and arsenic in first group of lower zone wells, Old Rifle Range.

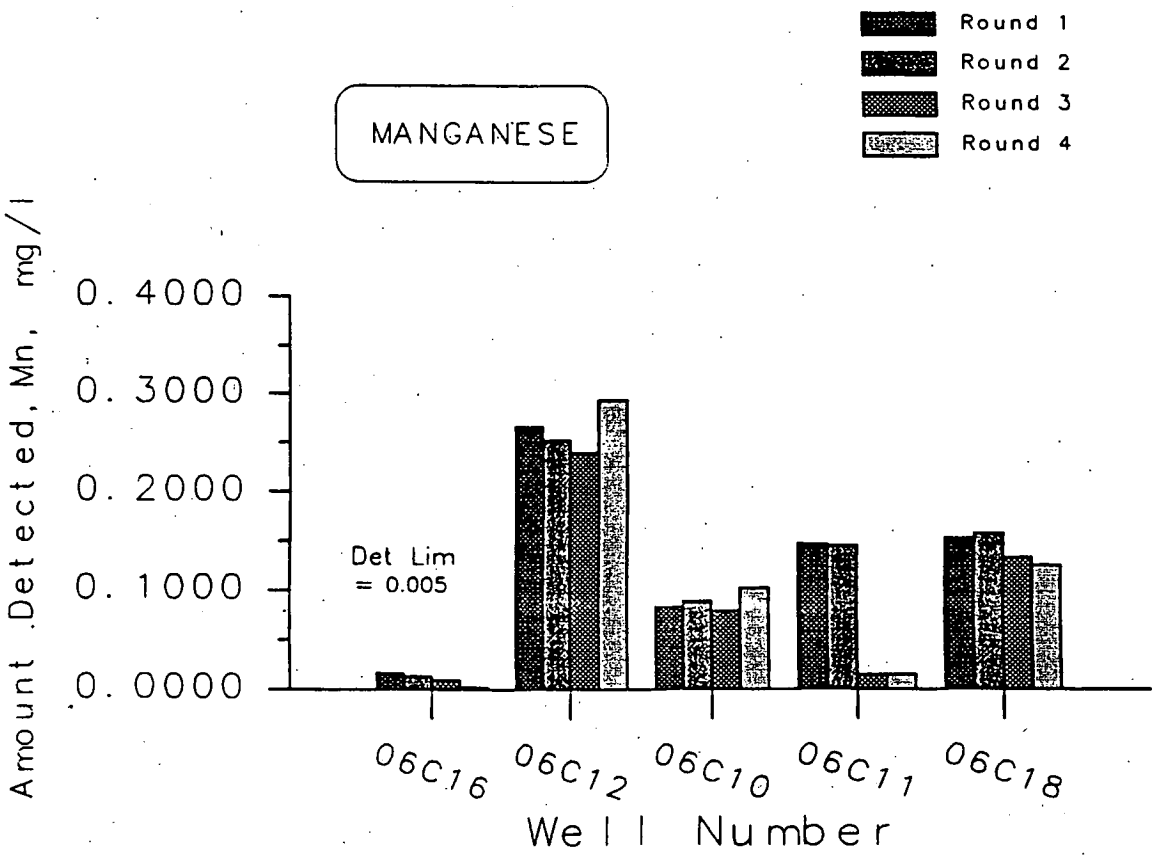


Figure 44A. Levels of manganese detected in first group of low zone wells, Old Rifle Range.

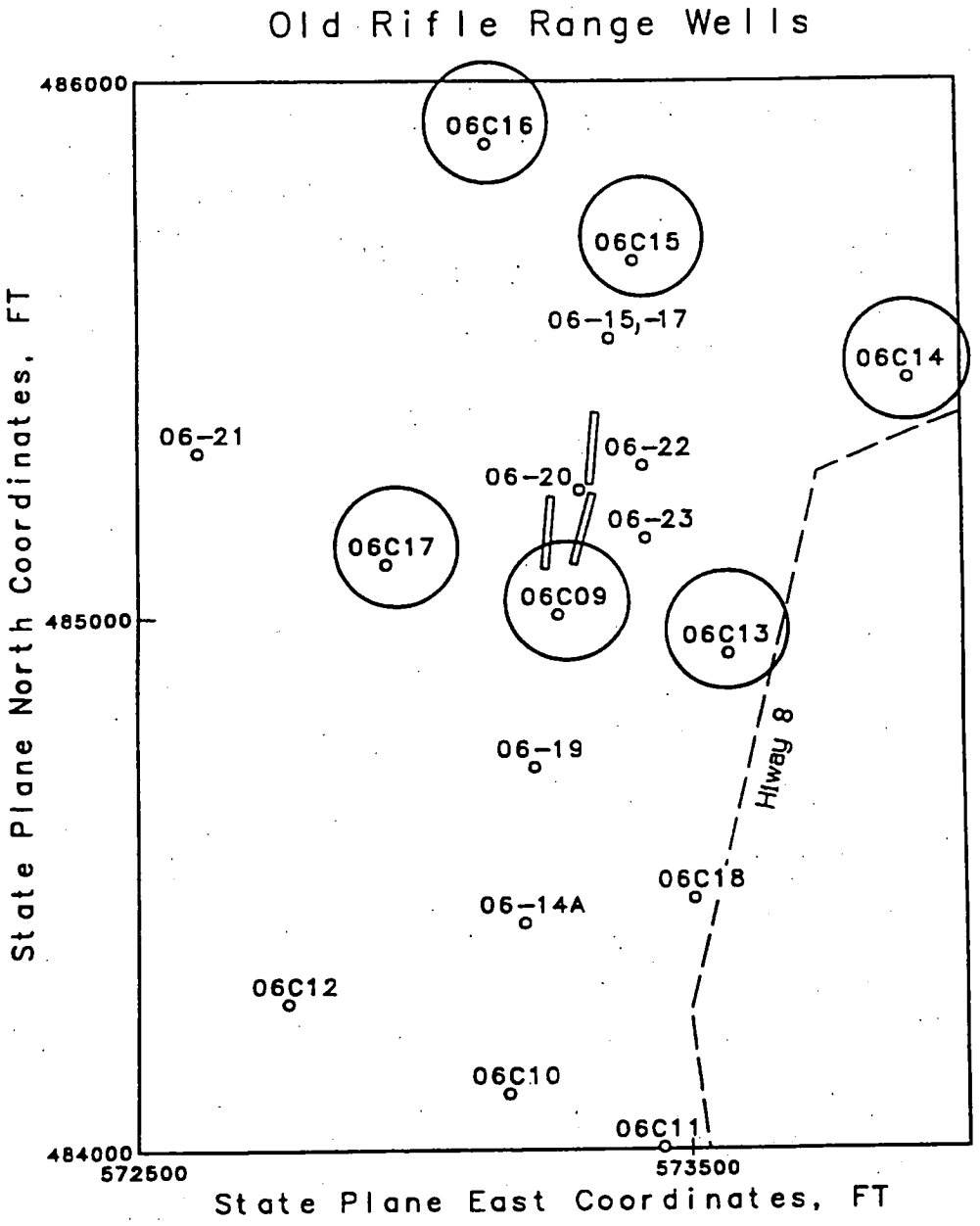


Figure 45. Second group of lower zone wells, Old Rifle Range.

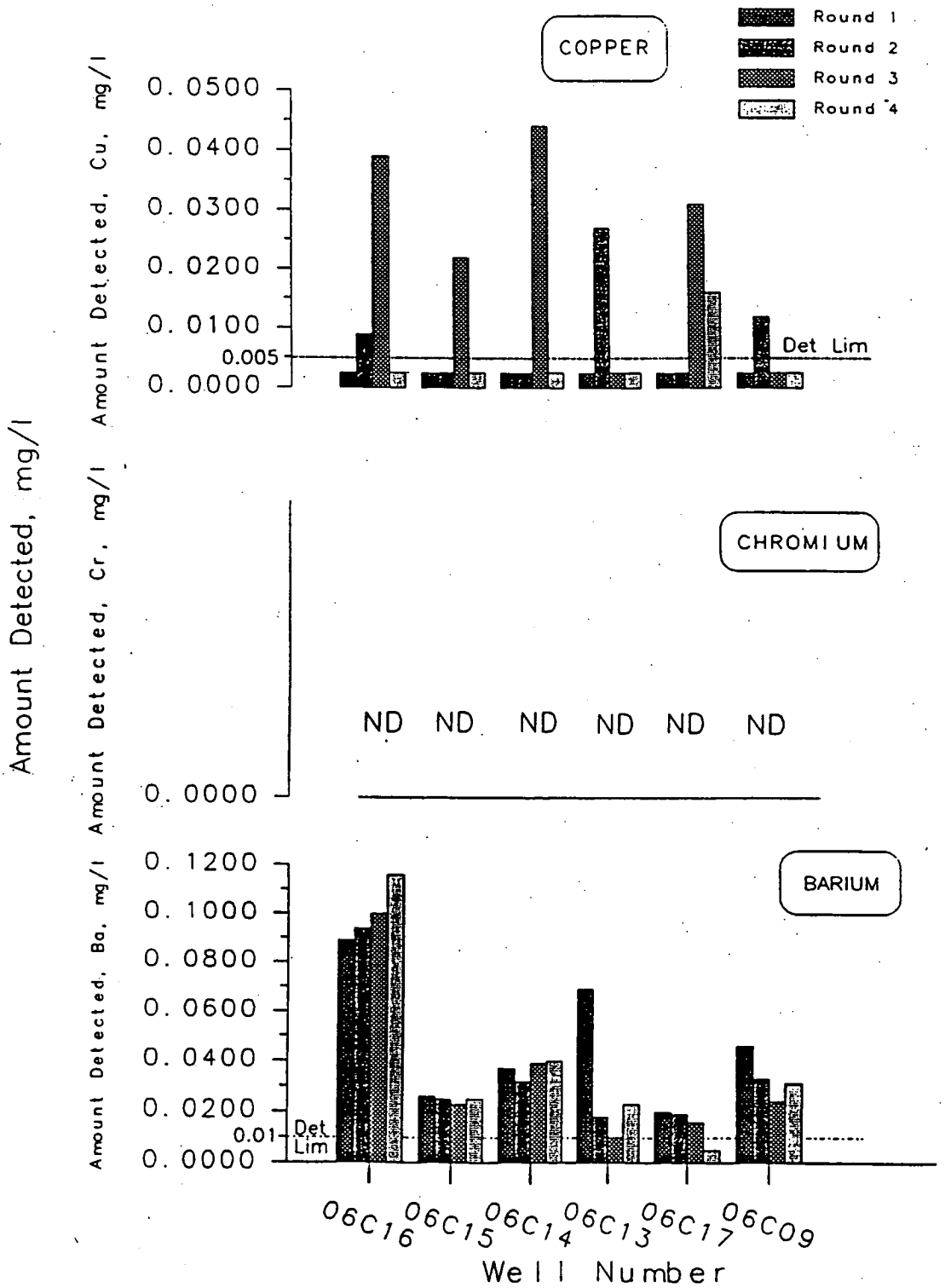


Figure 46. Levels of copper, chromium and barium in second group of lower zone wells, Old Rifle Range.

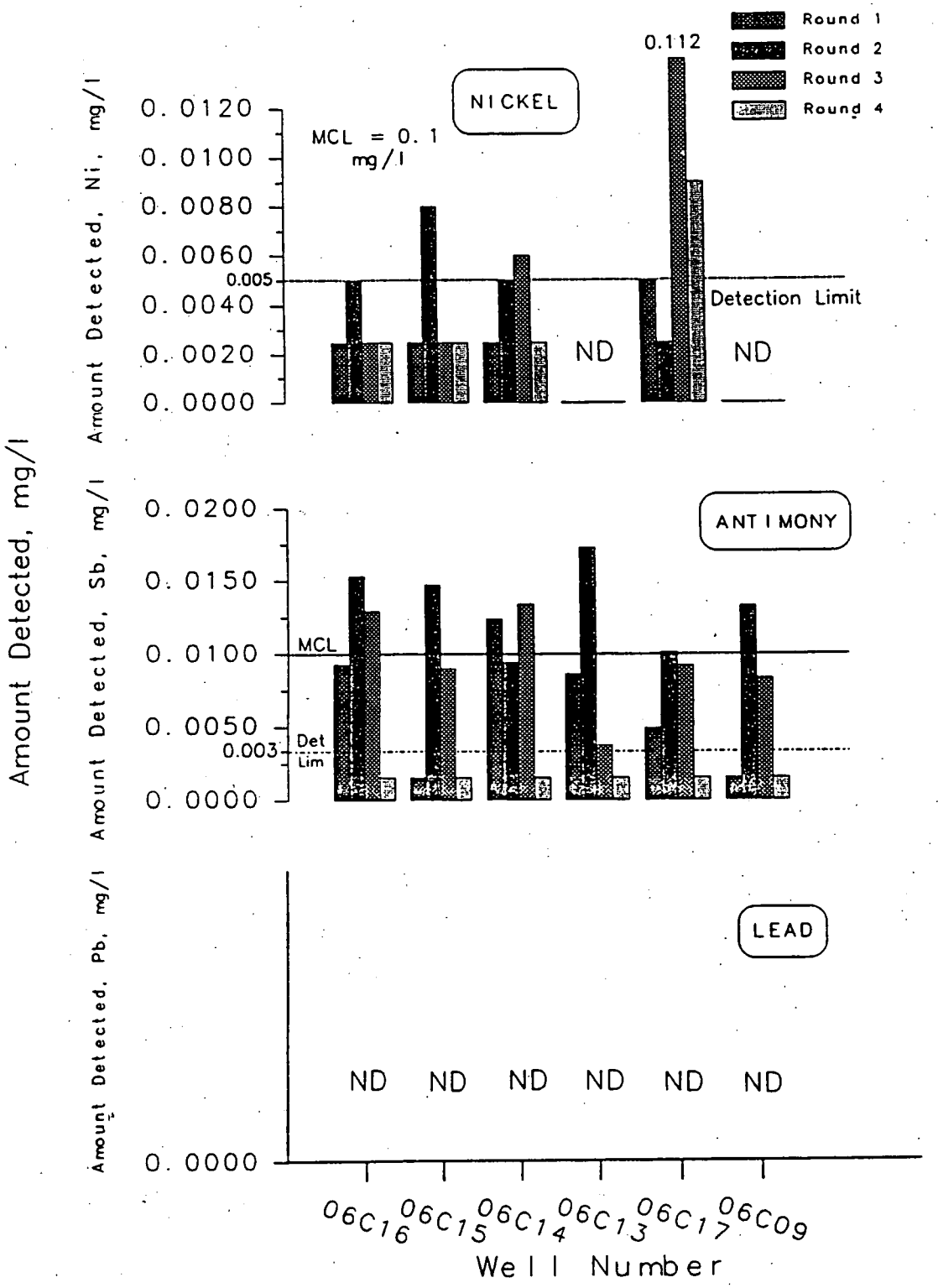


Figure 47. Levels of nickel, antimony and lead in second group of lower zone wells, Old Rifle Range.

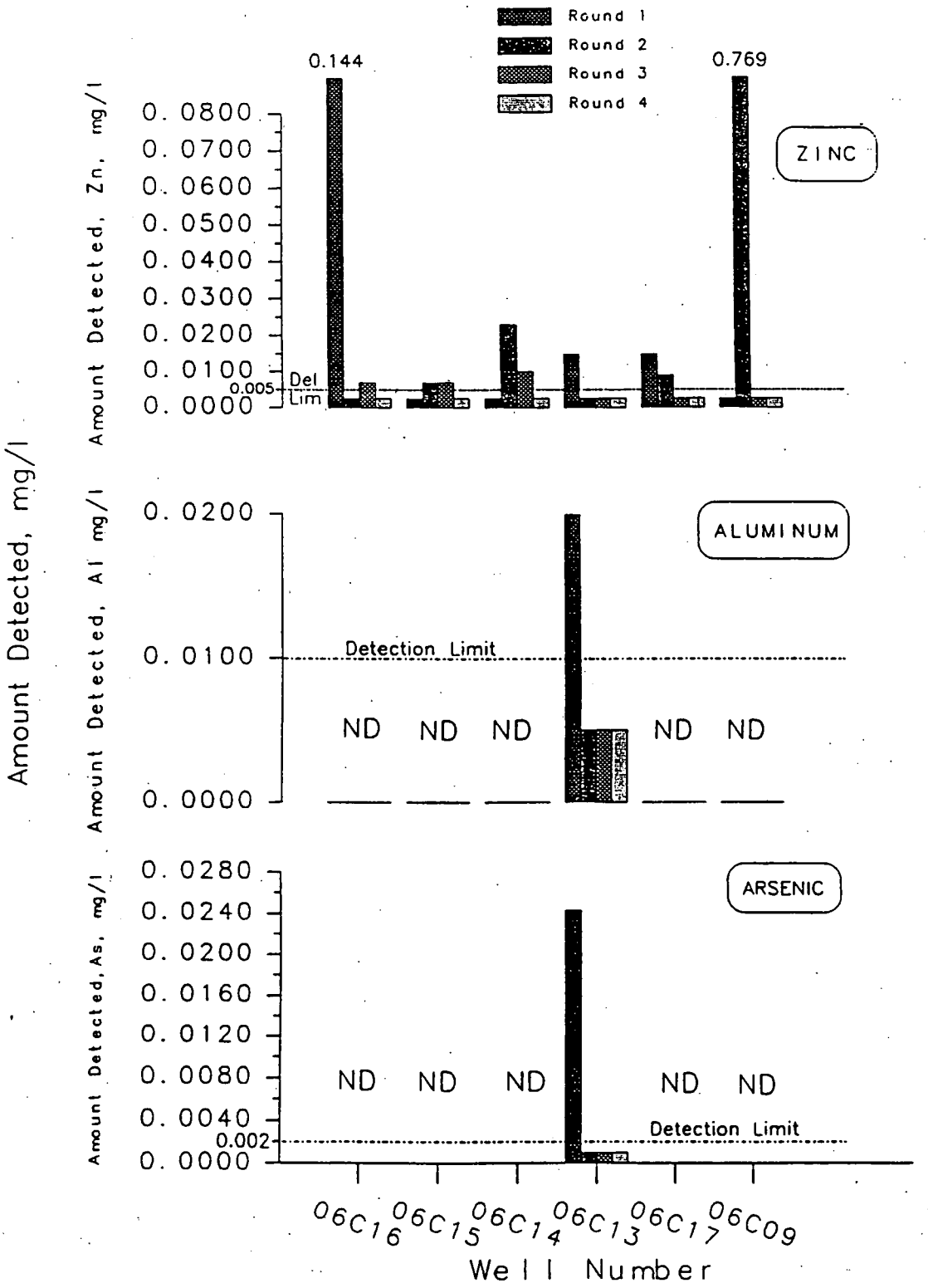


Figure ~~48~~ 57. Levels of zinc, aluminum and arsenic in second group of lower zone wells, Old Rifle Range.

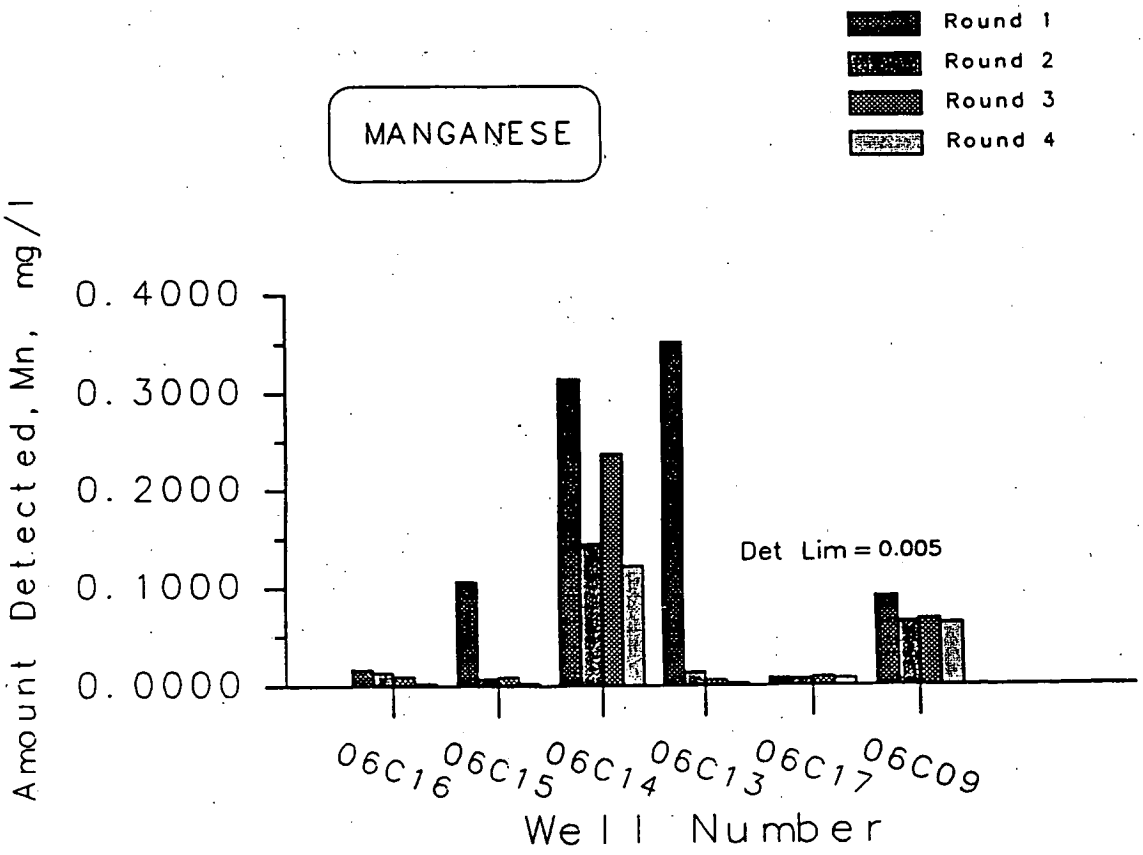


Figure 48A. Levels of manganese detected in second group of lower zone wells, Old Rifle Range.

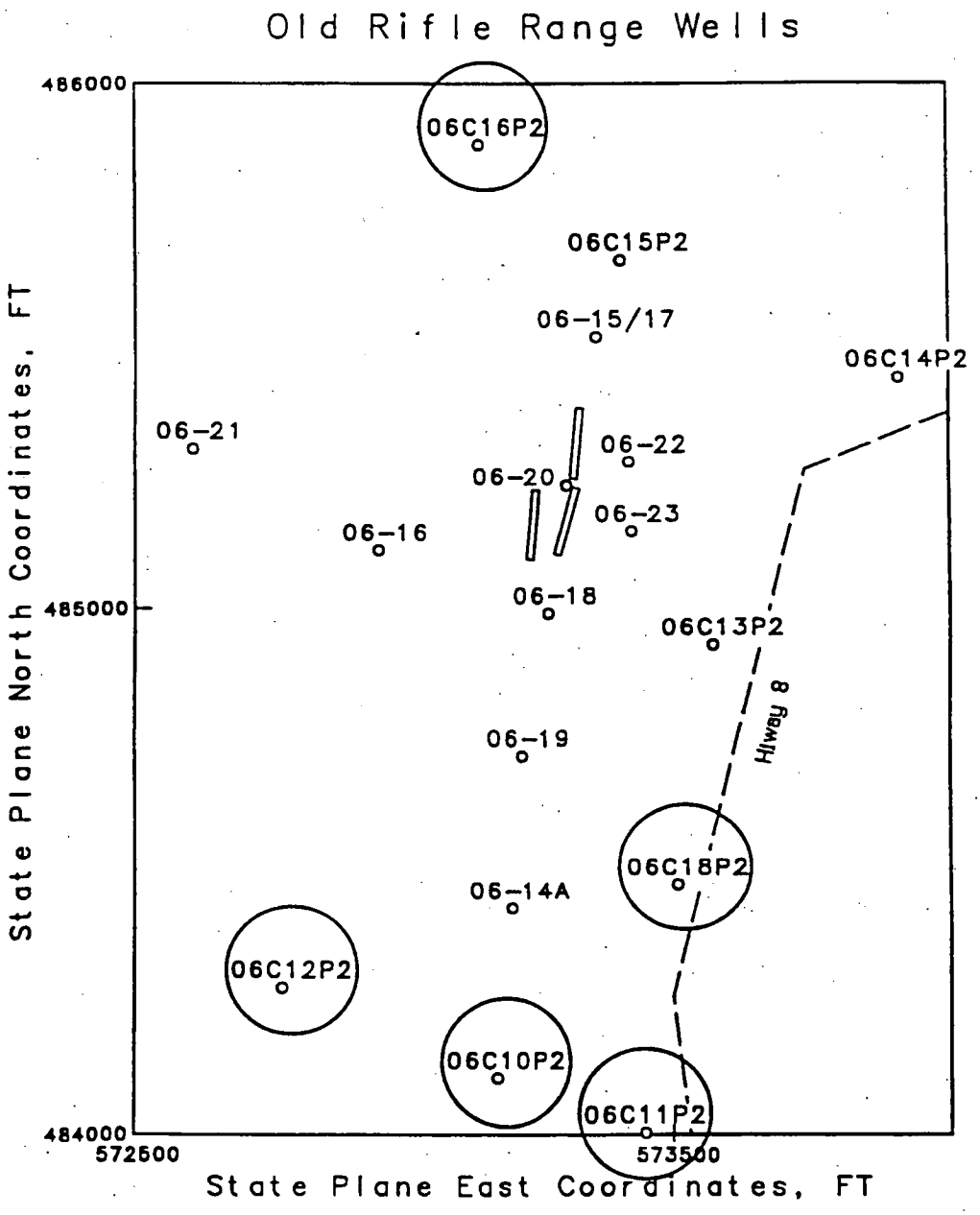


Figure ~~49~~ 59. First group of upper zone wells, Old Rifle Range.

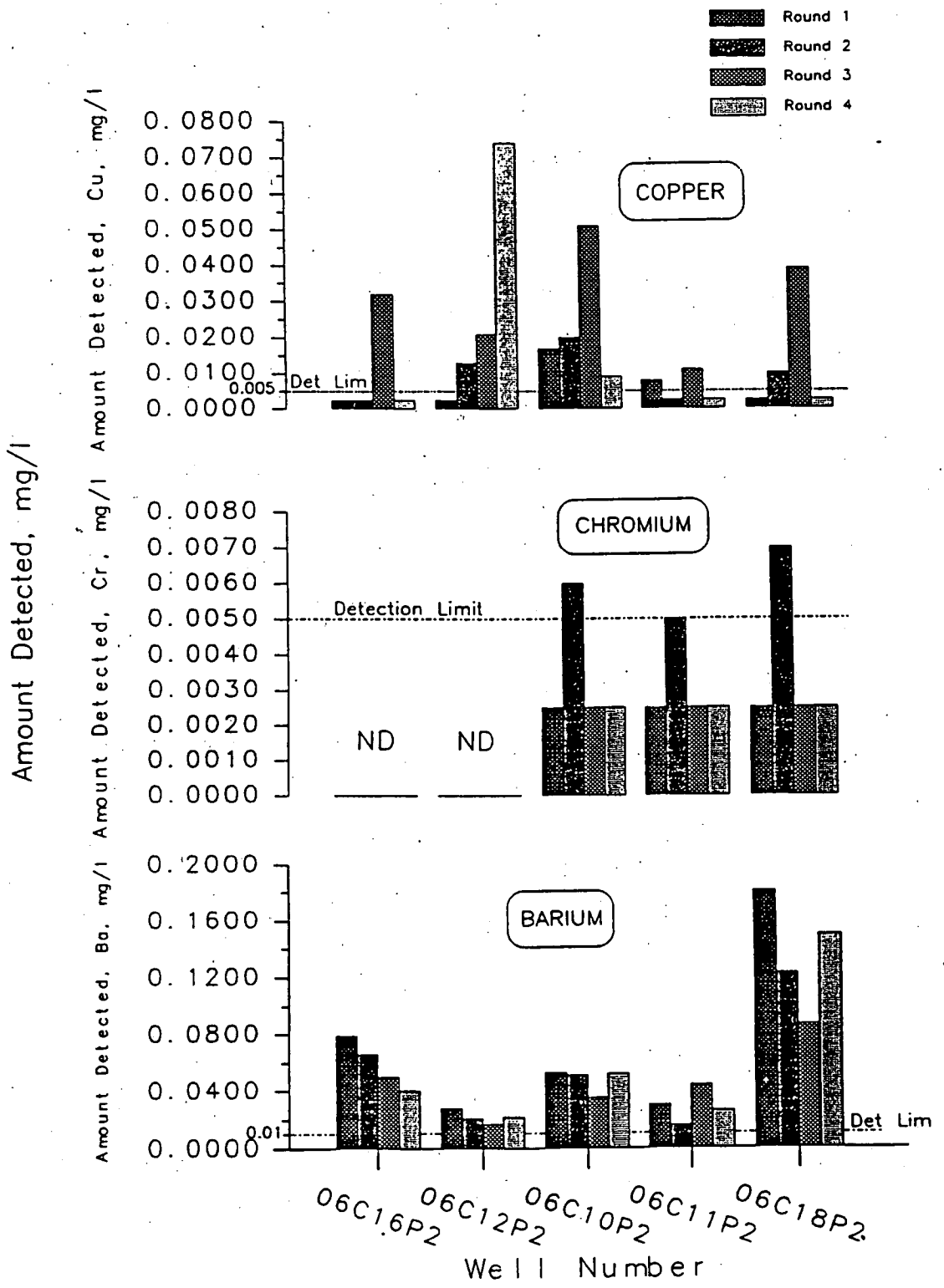


Figure 50. Levels of copper, chromium and barium in first group of upper zone wells, Old Rifle Range.

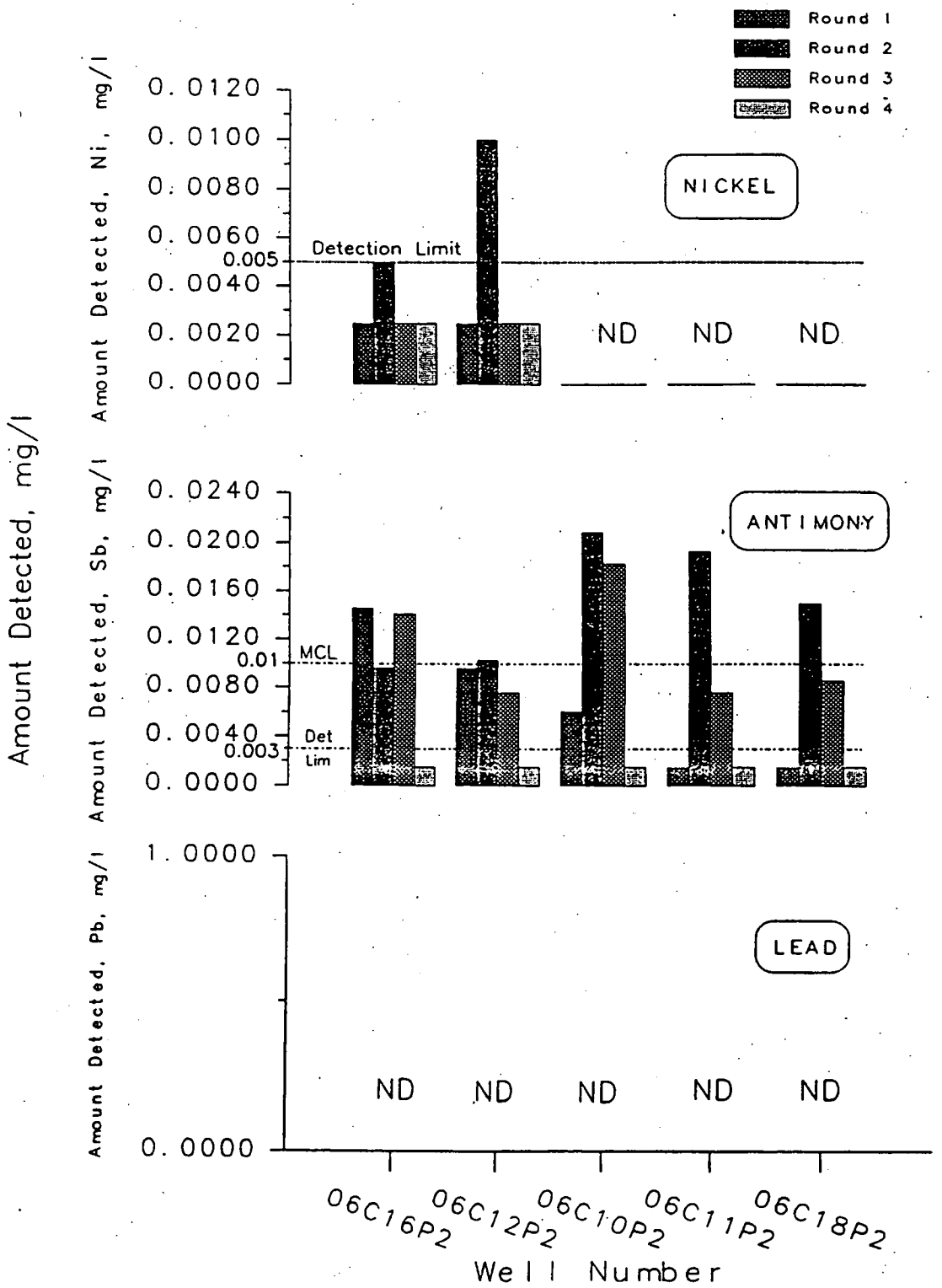


Figure 51. Levels of nickel, antimony and lead in first group of upper zone wells, Old Rifle Range.

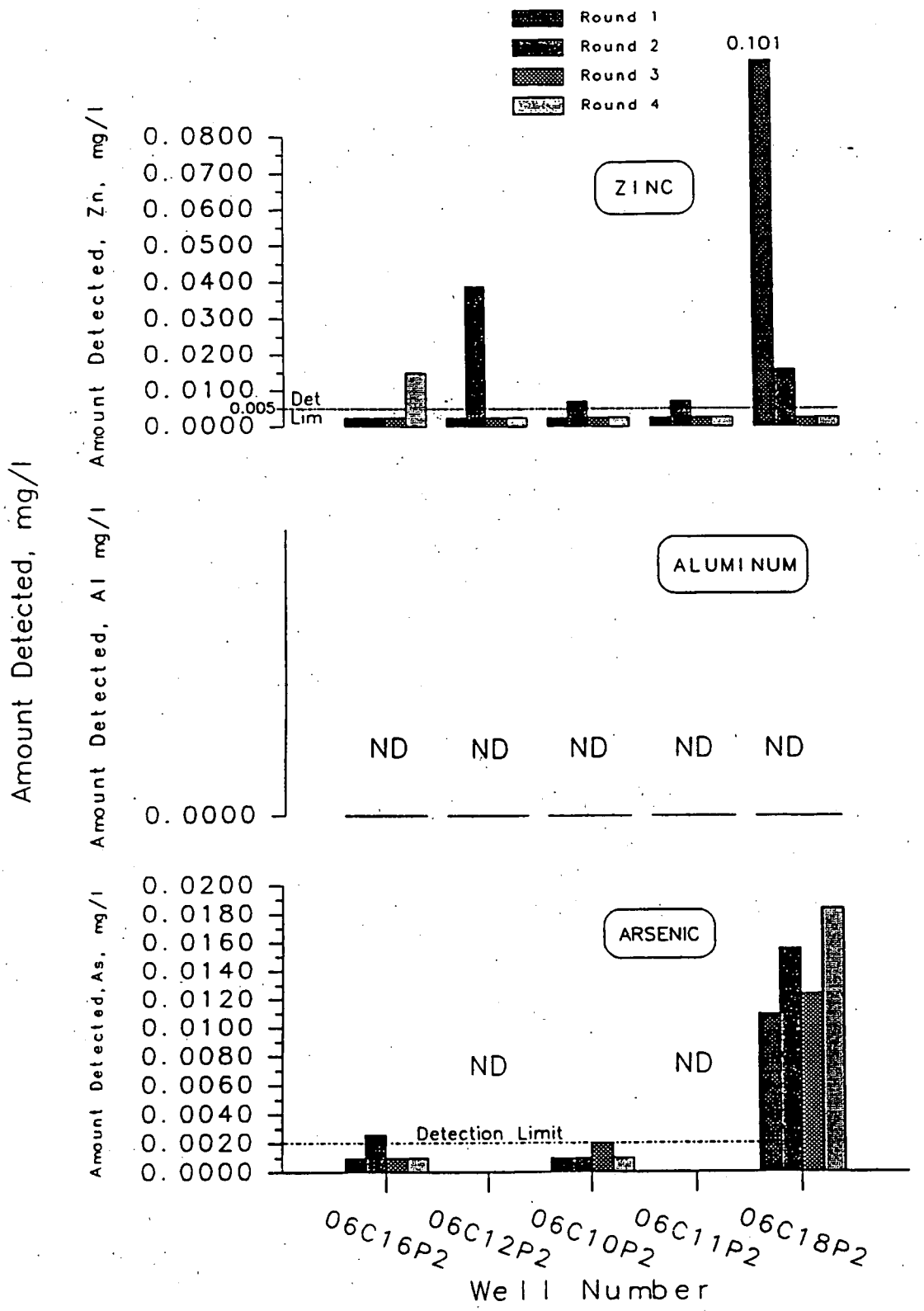


Figure 52. Levels of zinc, aluminum and arsenic in first group of upper zone wells, Old Rifle Range.

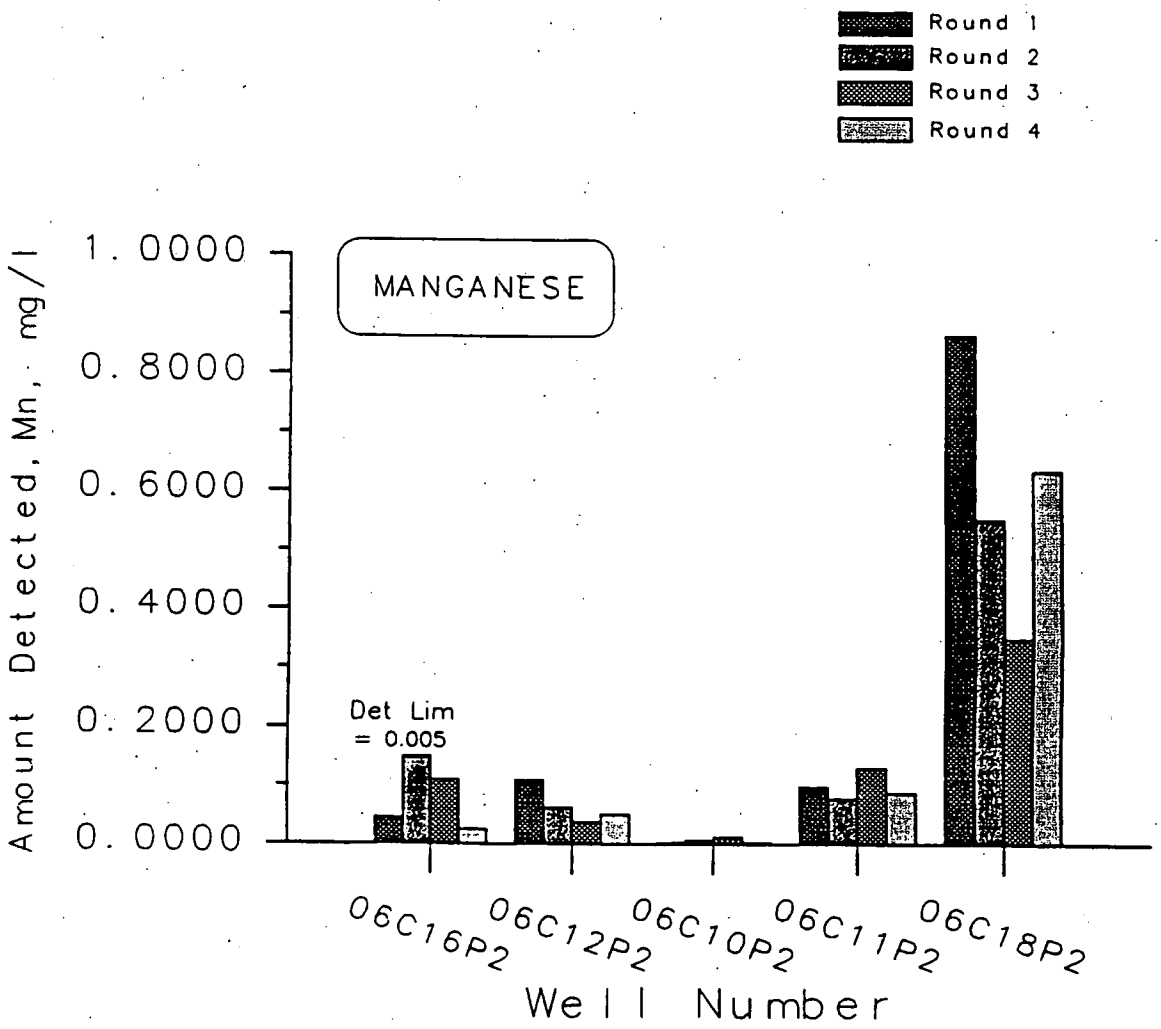


Figure ~~52~~63A. Levels of manganese detected in first group of upper zone wells, Old Rifle Range.

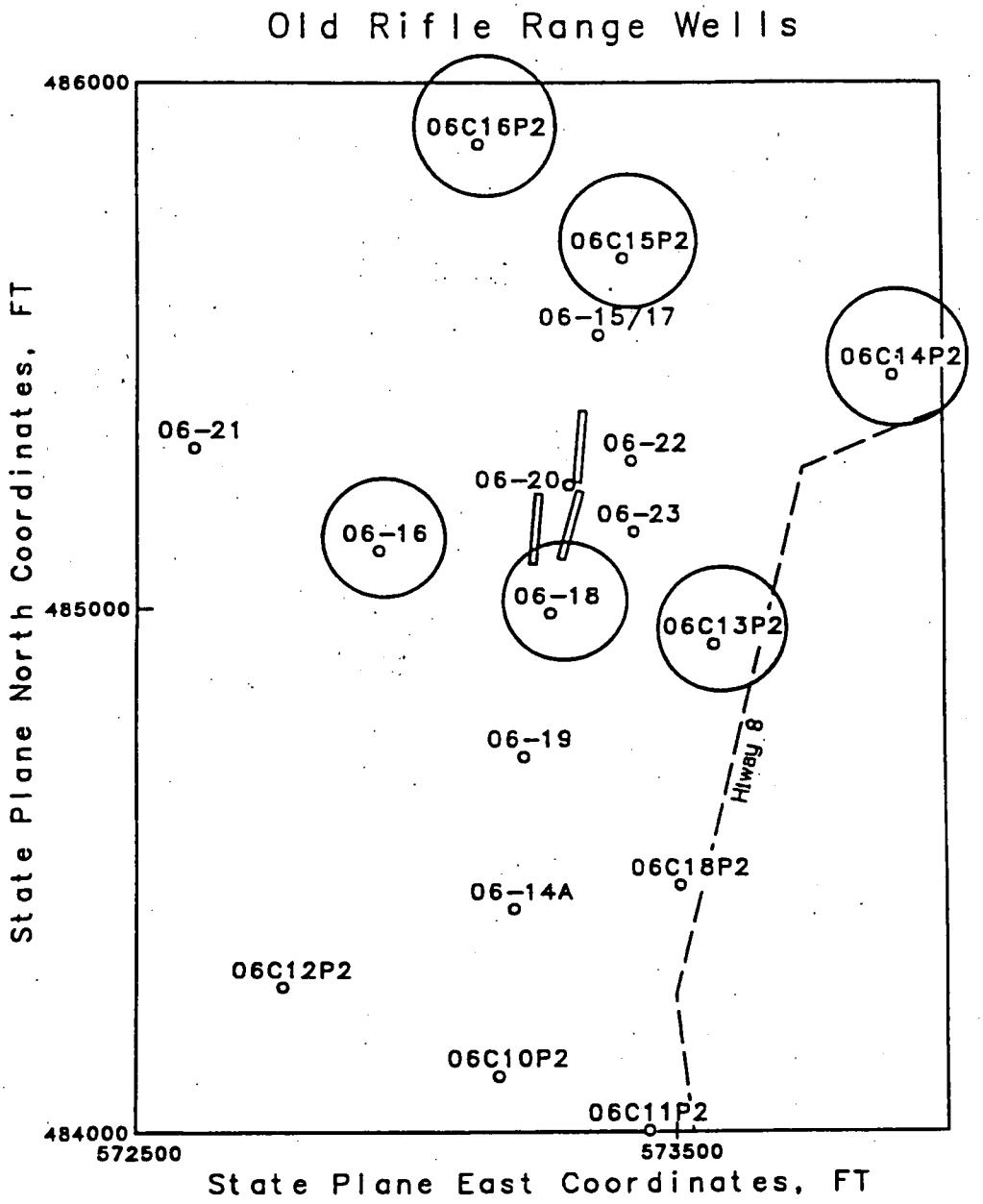


Figure 5~~3~~b. Second group of upper zone wells, Old Rifle Range.

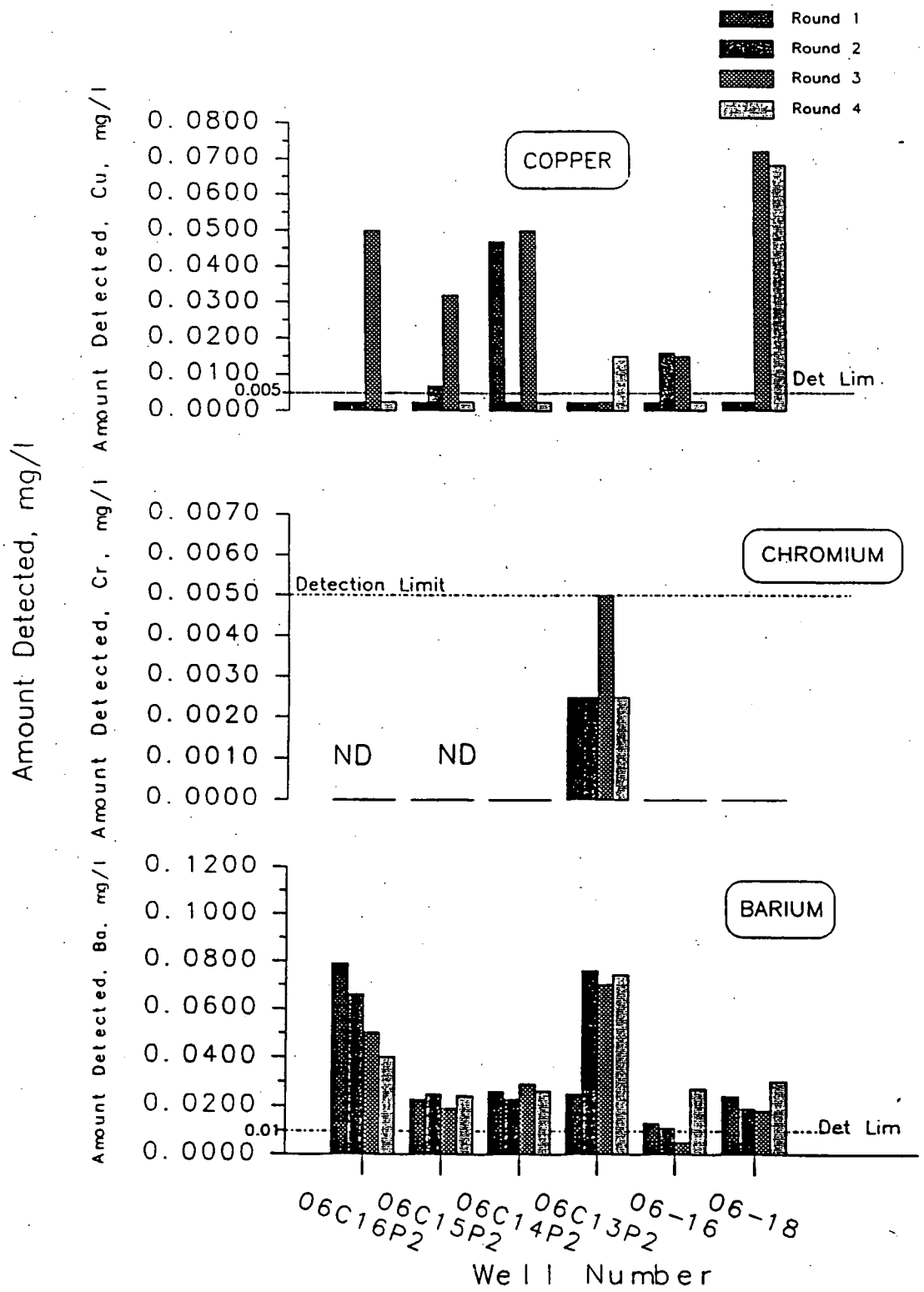


Figure 5~~4~~6. Levels of copper, chromium and barium in upper zone wells, Old Rifle Range.

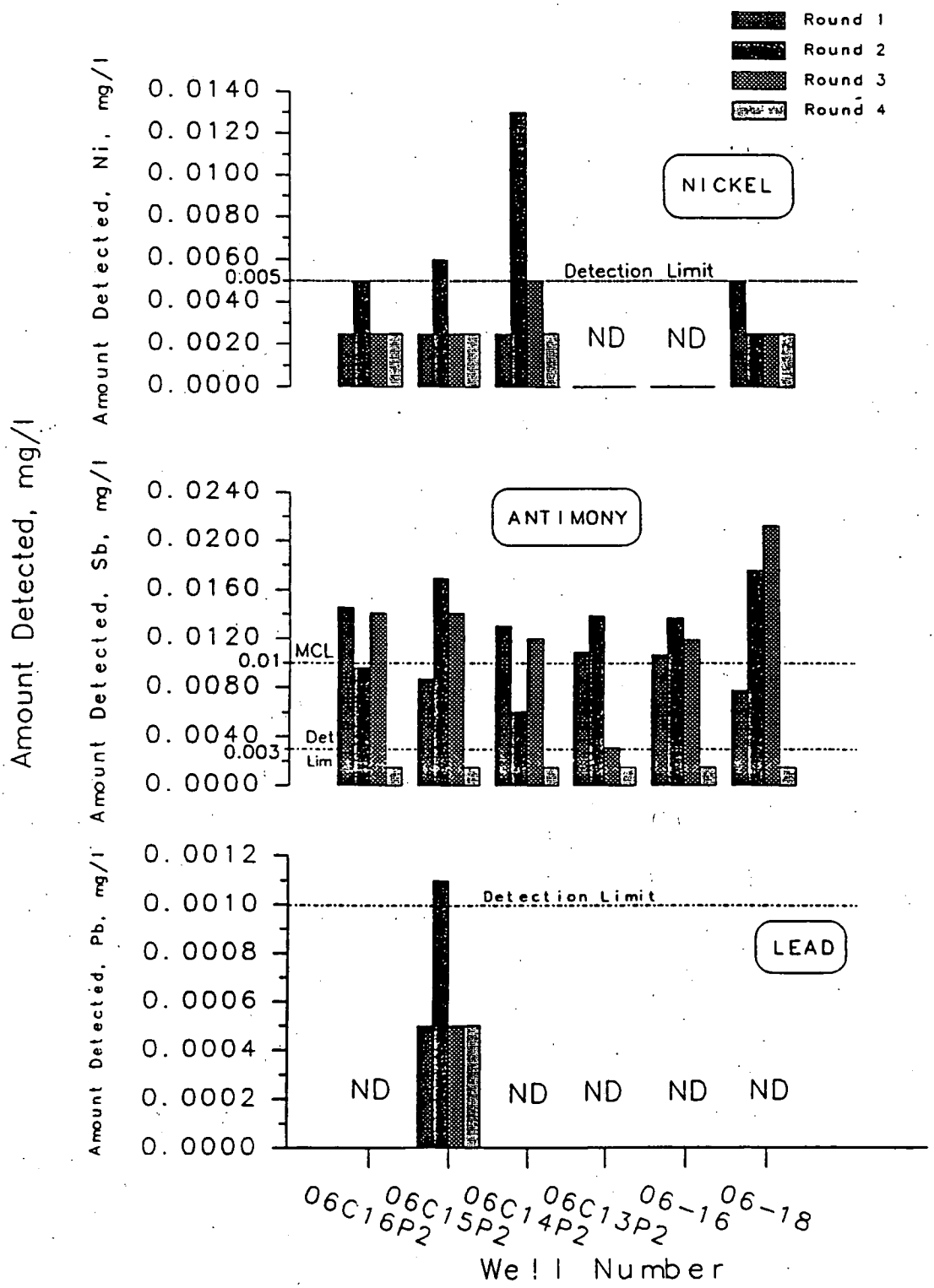


Figure 55. Levels of nickel, antimony and lead in upper zone wells, Old Rifle Range.

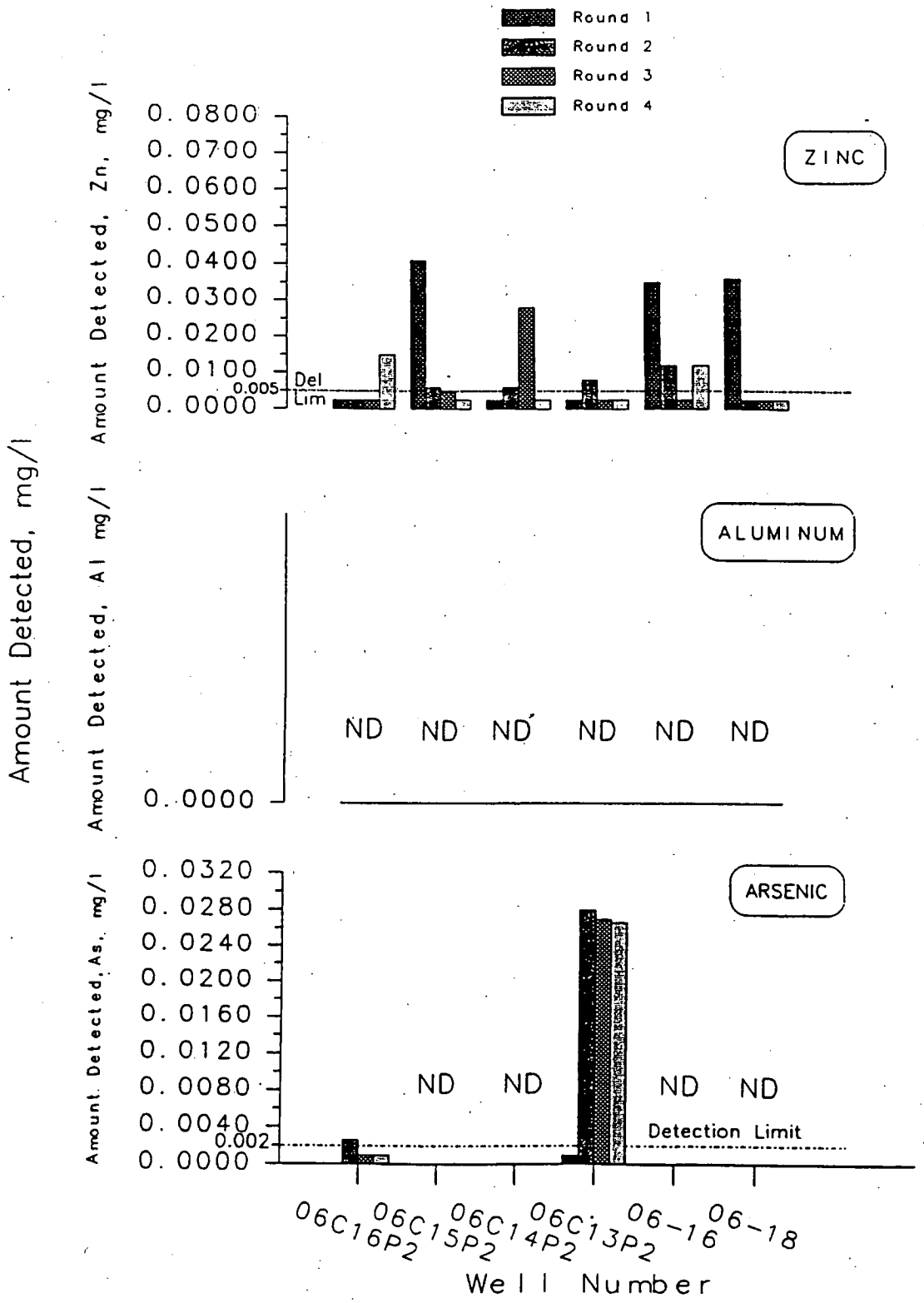


Figure 56. Levels of zinc, aluminum and arsenic in upper zone wells, Old Rifle Range.

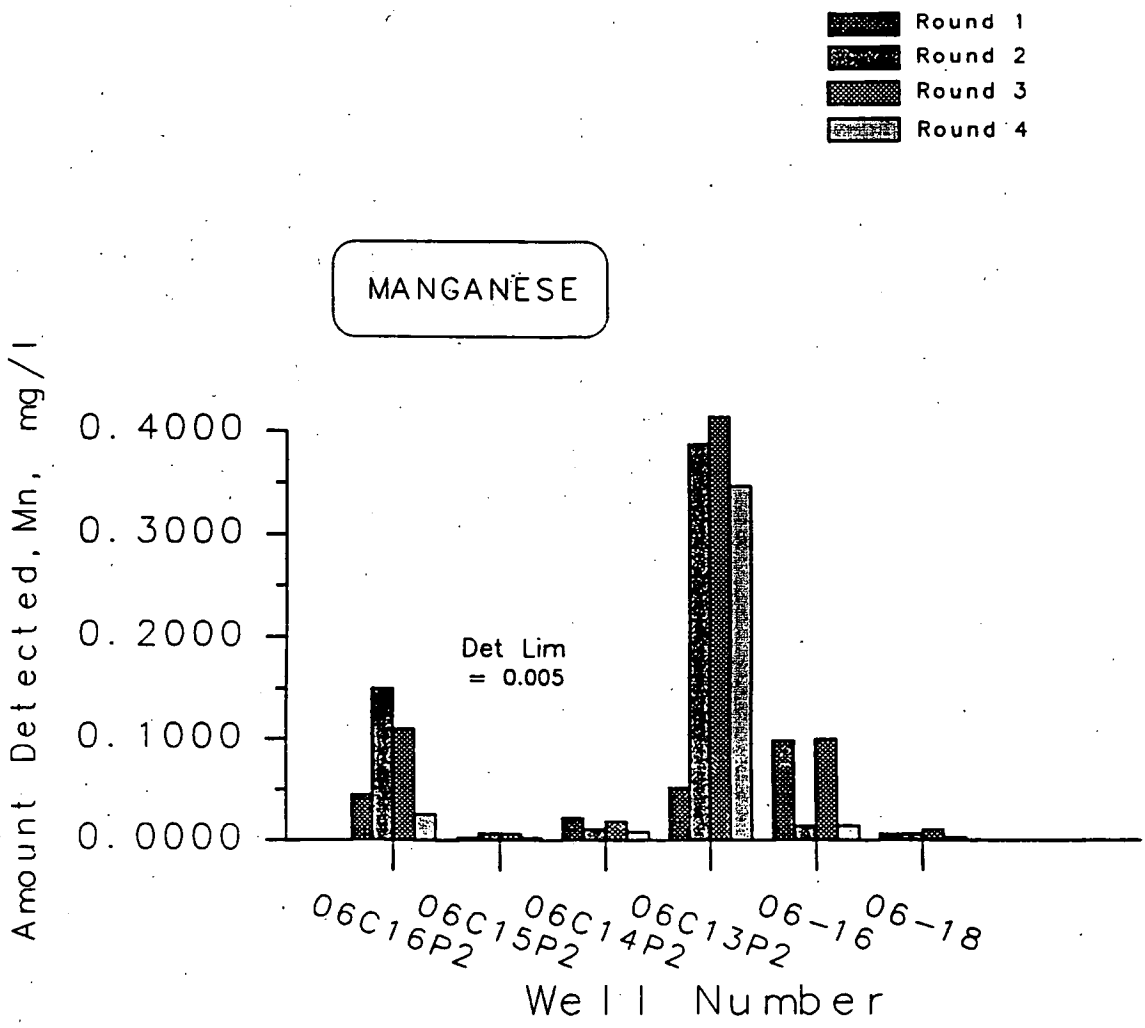


Figure 56A. Levels of manganese detected in second group of upper zone wells, Old Rifle Range.

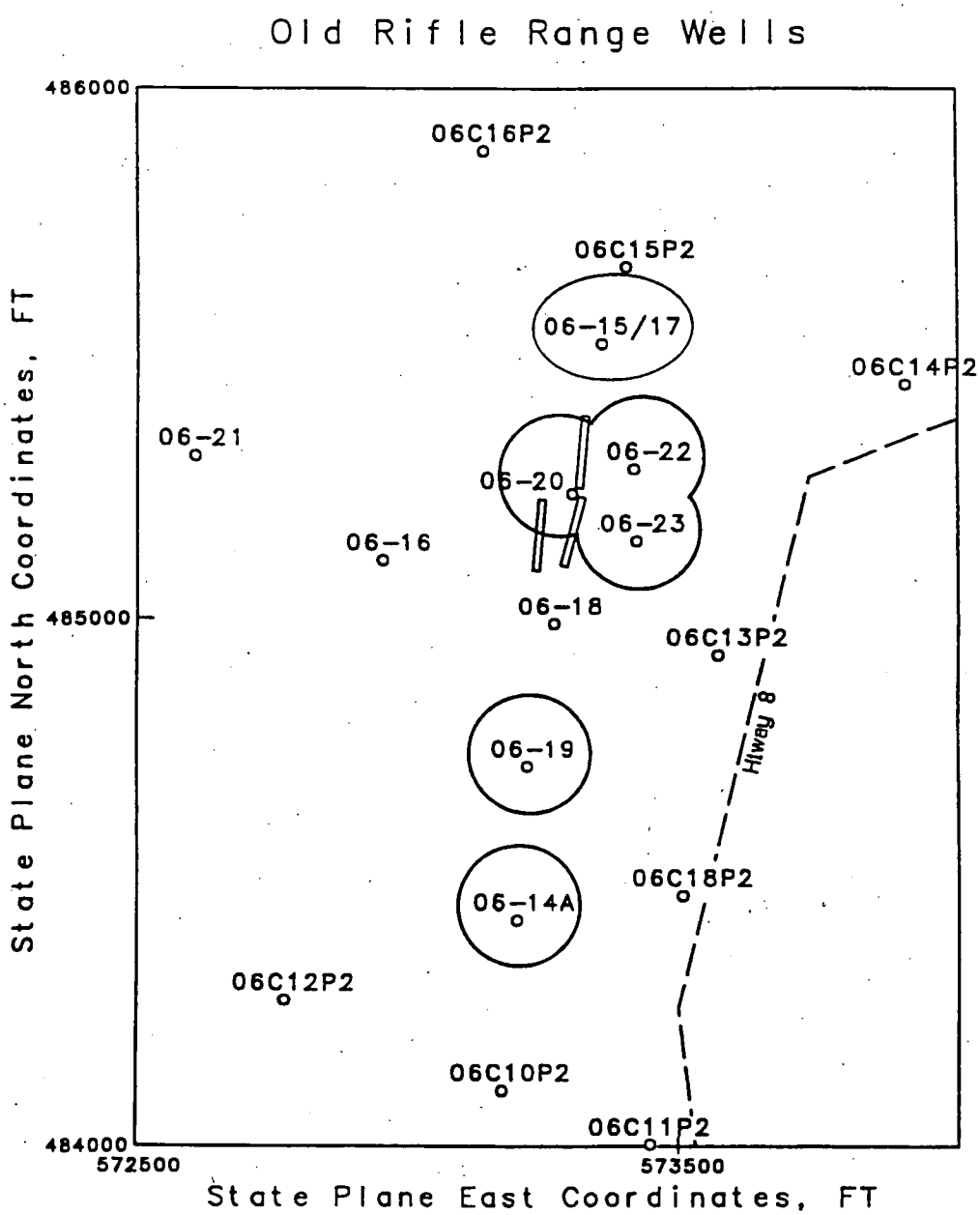


Figure 57. Third group of upper zone wells, Old Rifle Range.

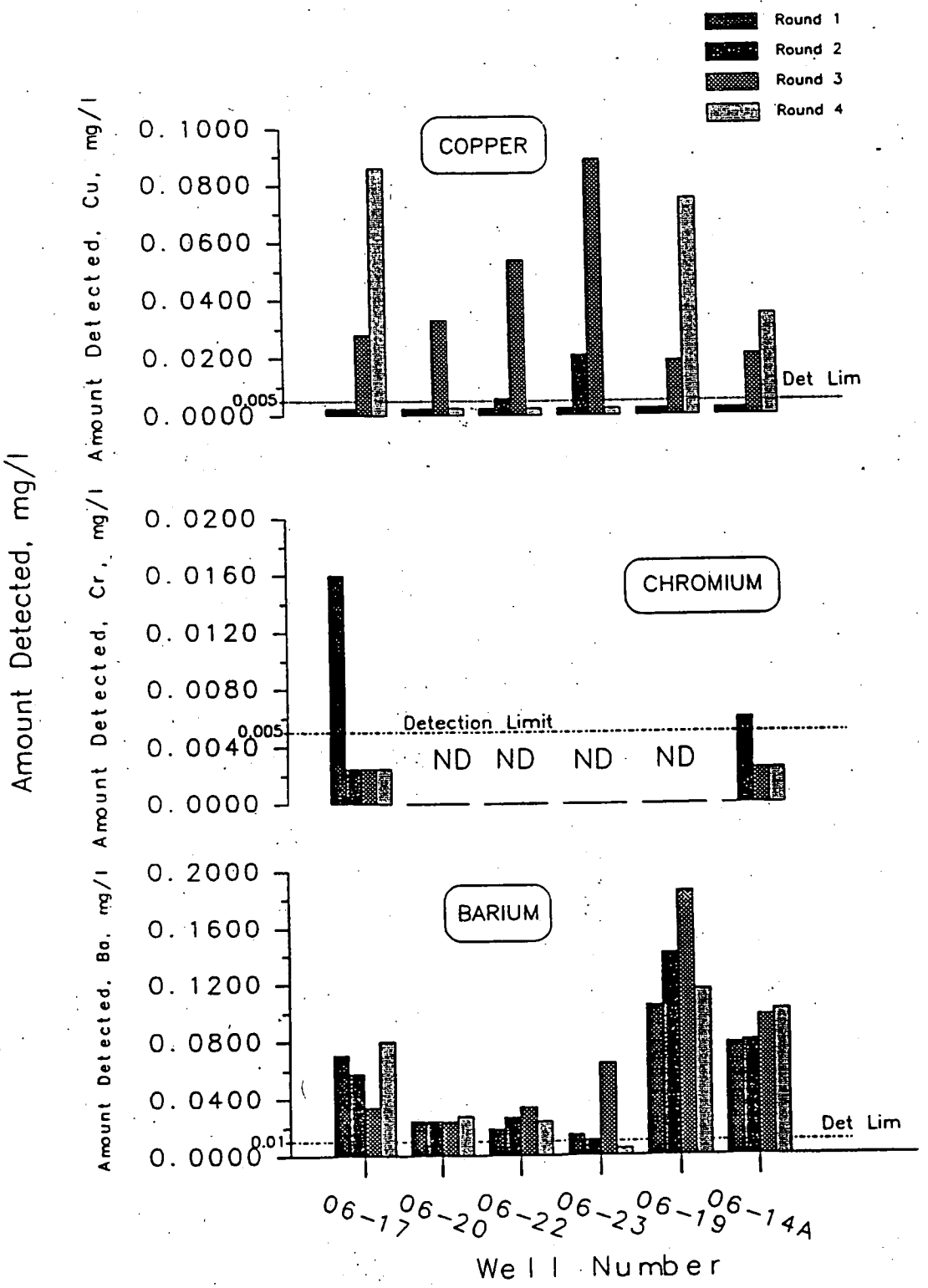


Figure 58. Levels of copper, chromium and barium in third group of upper zone wells, Old Rifle Range.

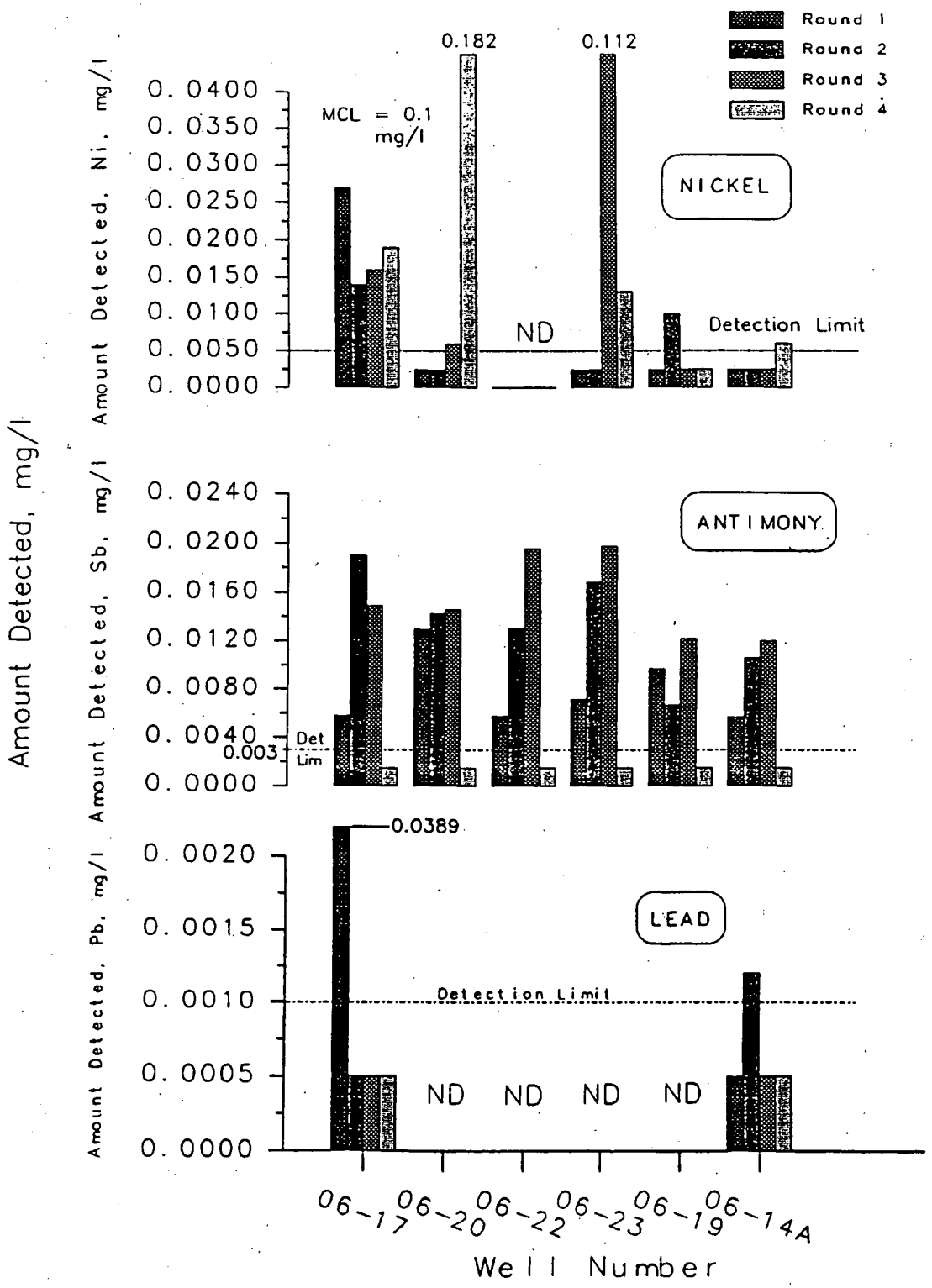


Figure 59. Levels of nickel, antimony and lead in third group of upper zone wells, Old Rifle Range.

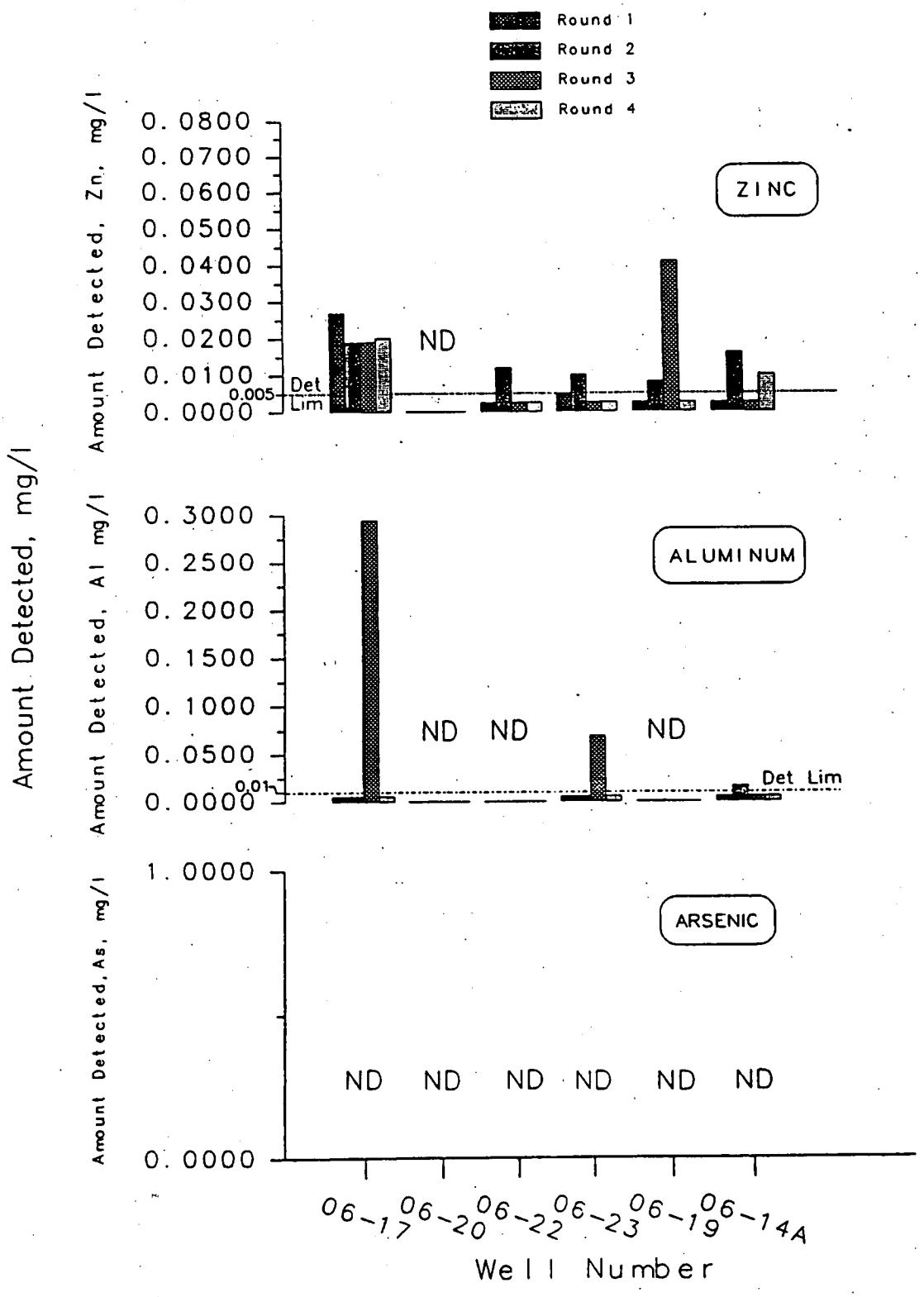


Figure 60. Levels of zinc, aluminum and arsenic in third group of upper zone wells, Old Rifle Range.

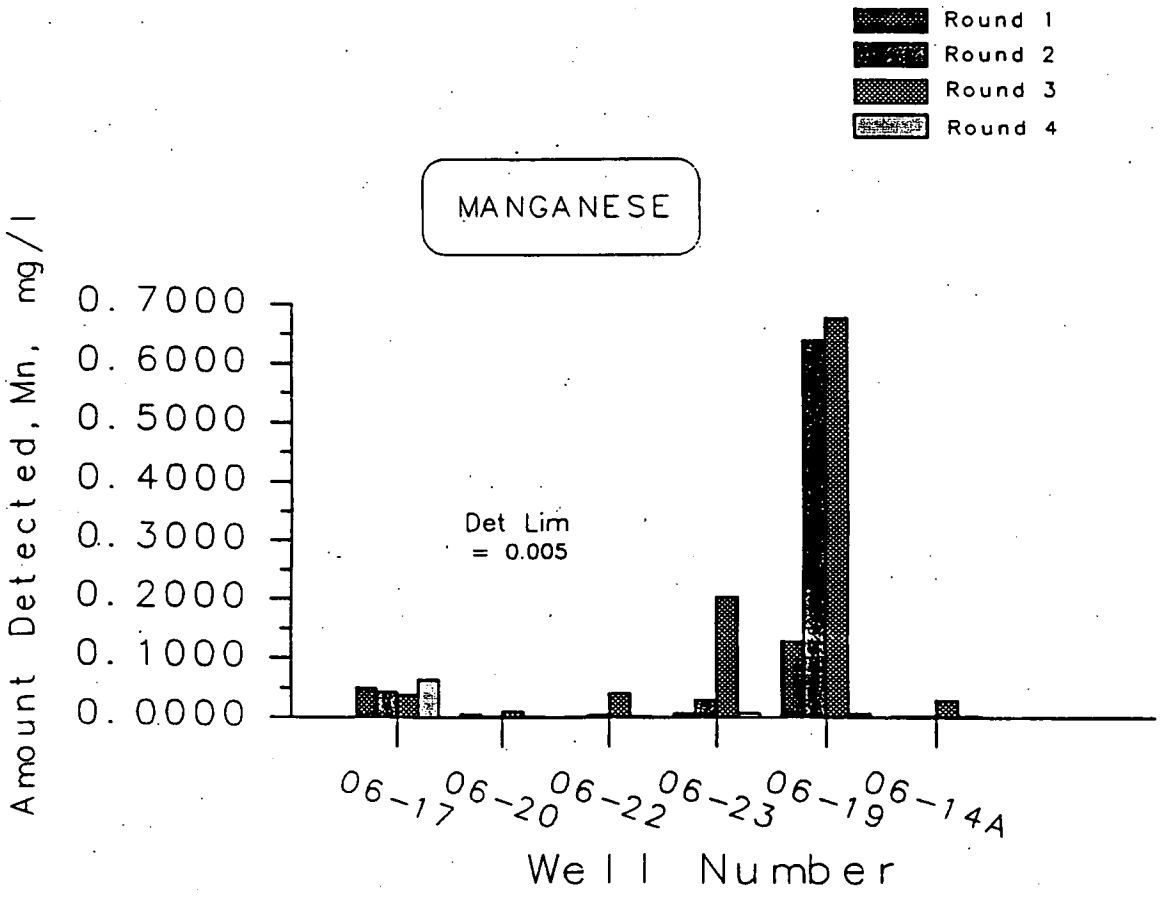


Figure ~~60~~ 73A. Levels of manganese detected in third group of upper zone wells, Old Rifle Range.

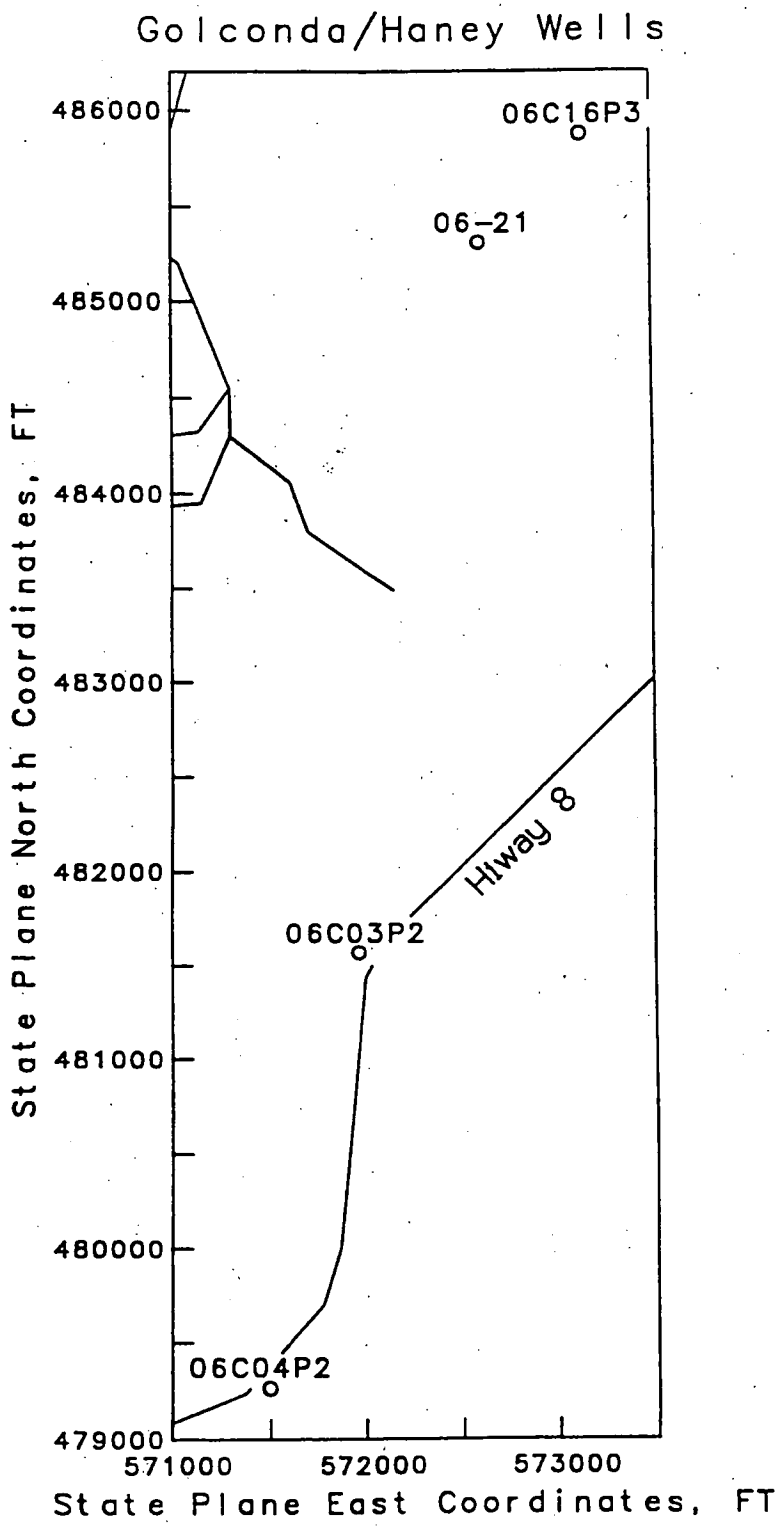


Figure ~~61~~ 74. Golconda/Haney wells.

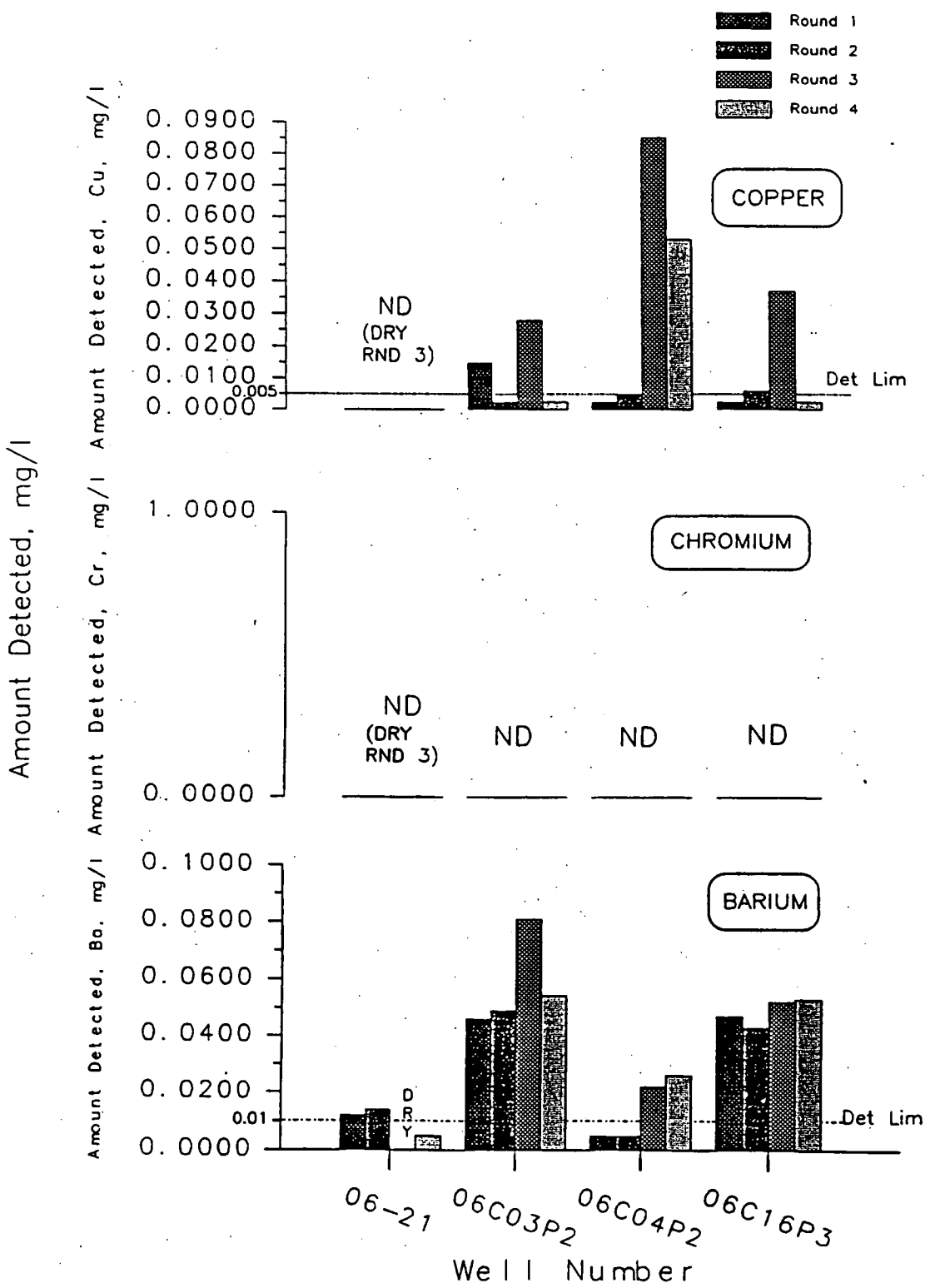


Figure 62. Levels of copper, chromium and barium in Golconda/Haney wells.

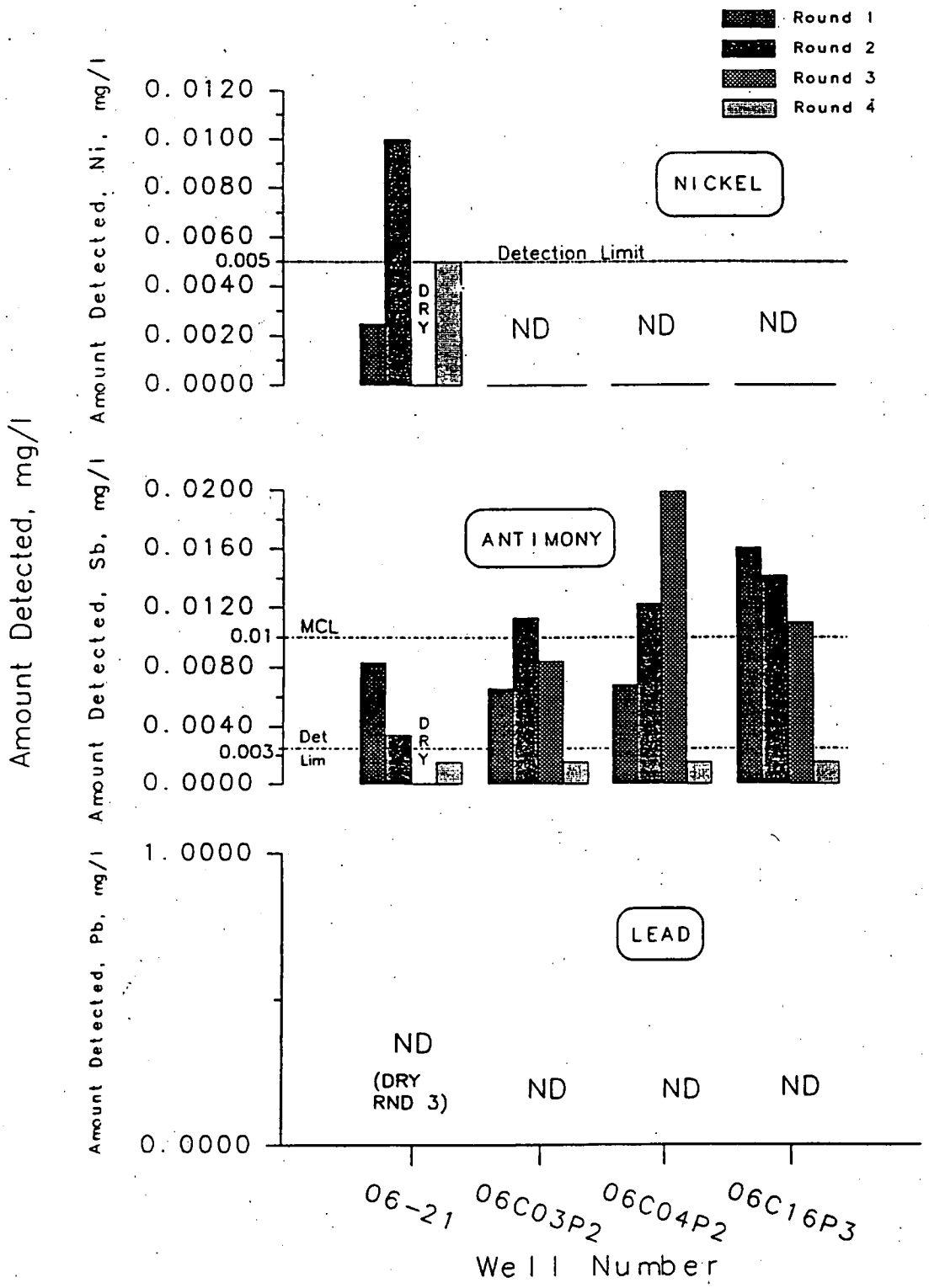


Figure 63. Levels of nickel, antimony and lead in Golconda/Haney wells.

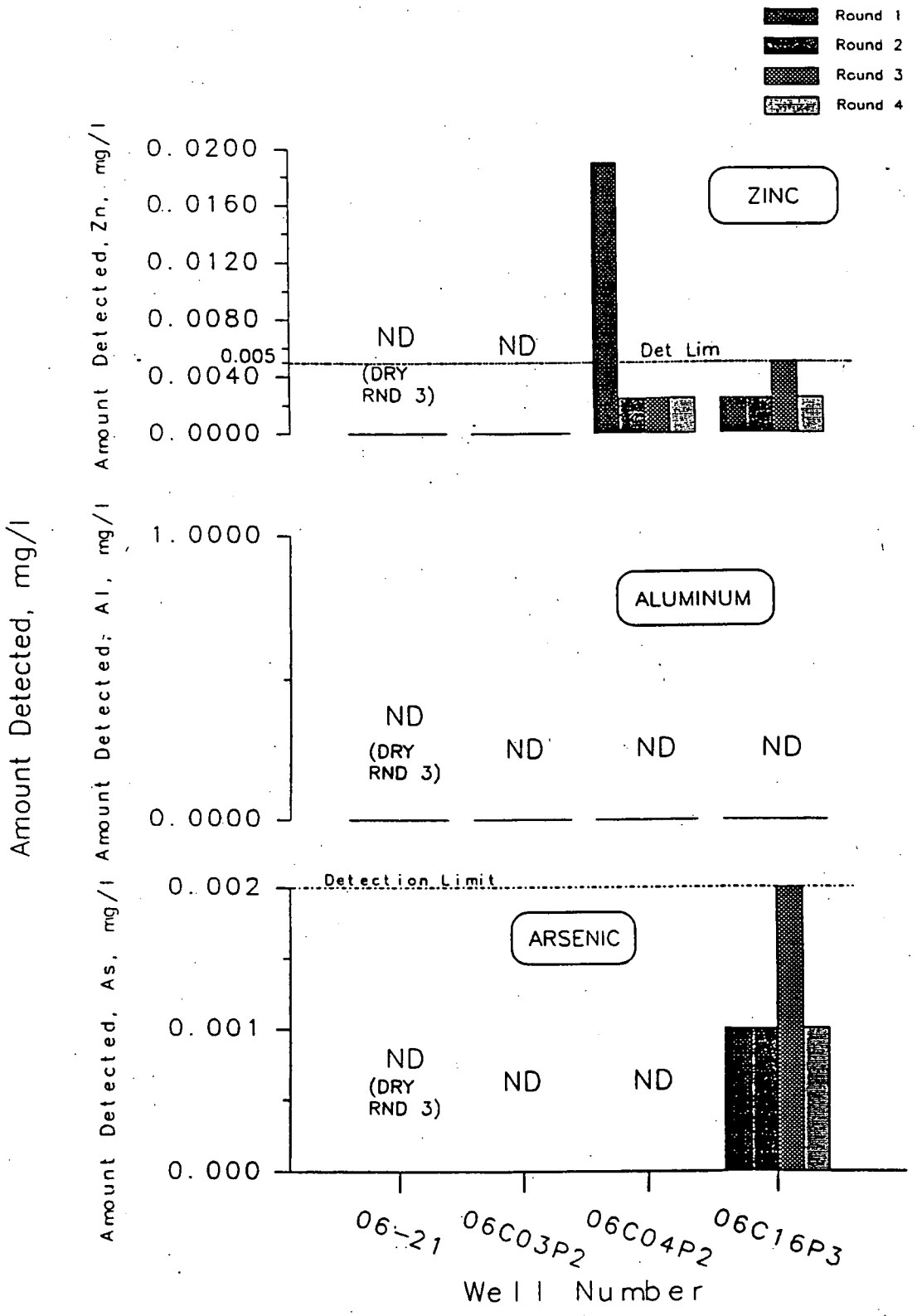


Figure 64. Levels of zinc, aluminum and arsenic in Golconda/Haney wells.

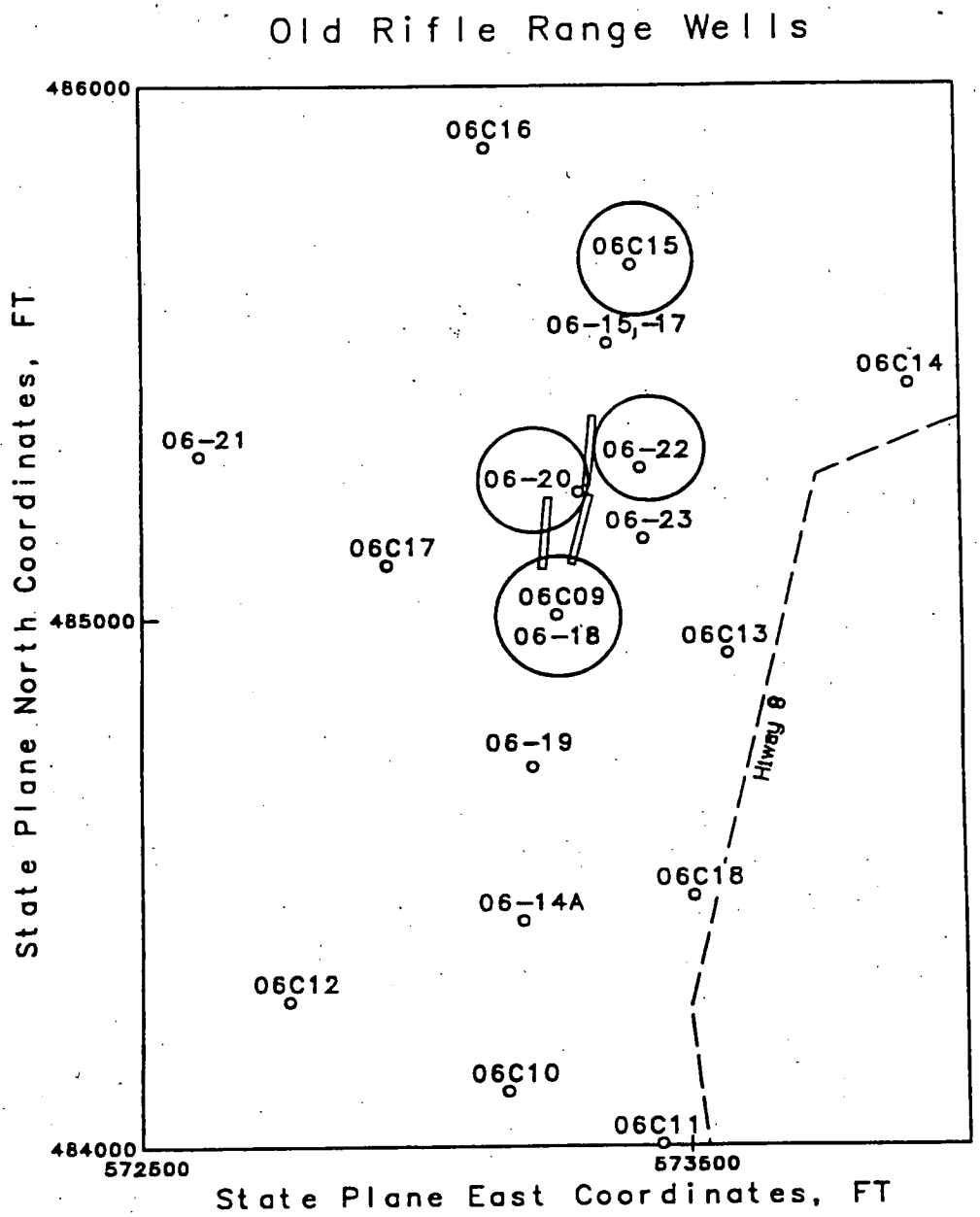


Figure 65. Wells with explosives, Old Rifle Range.

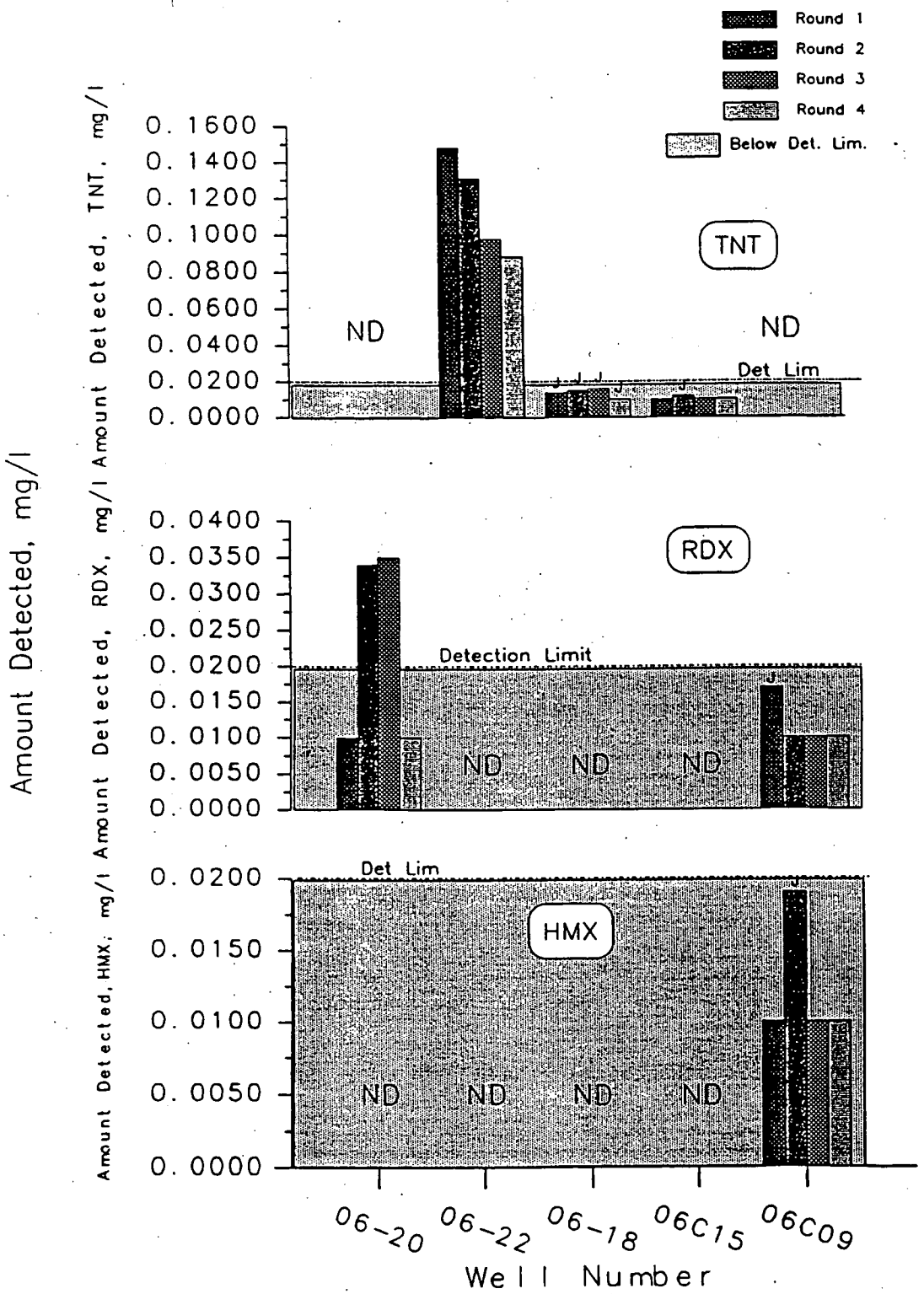


Figure 66. Levels of explosives, Old Rifle Range wells.

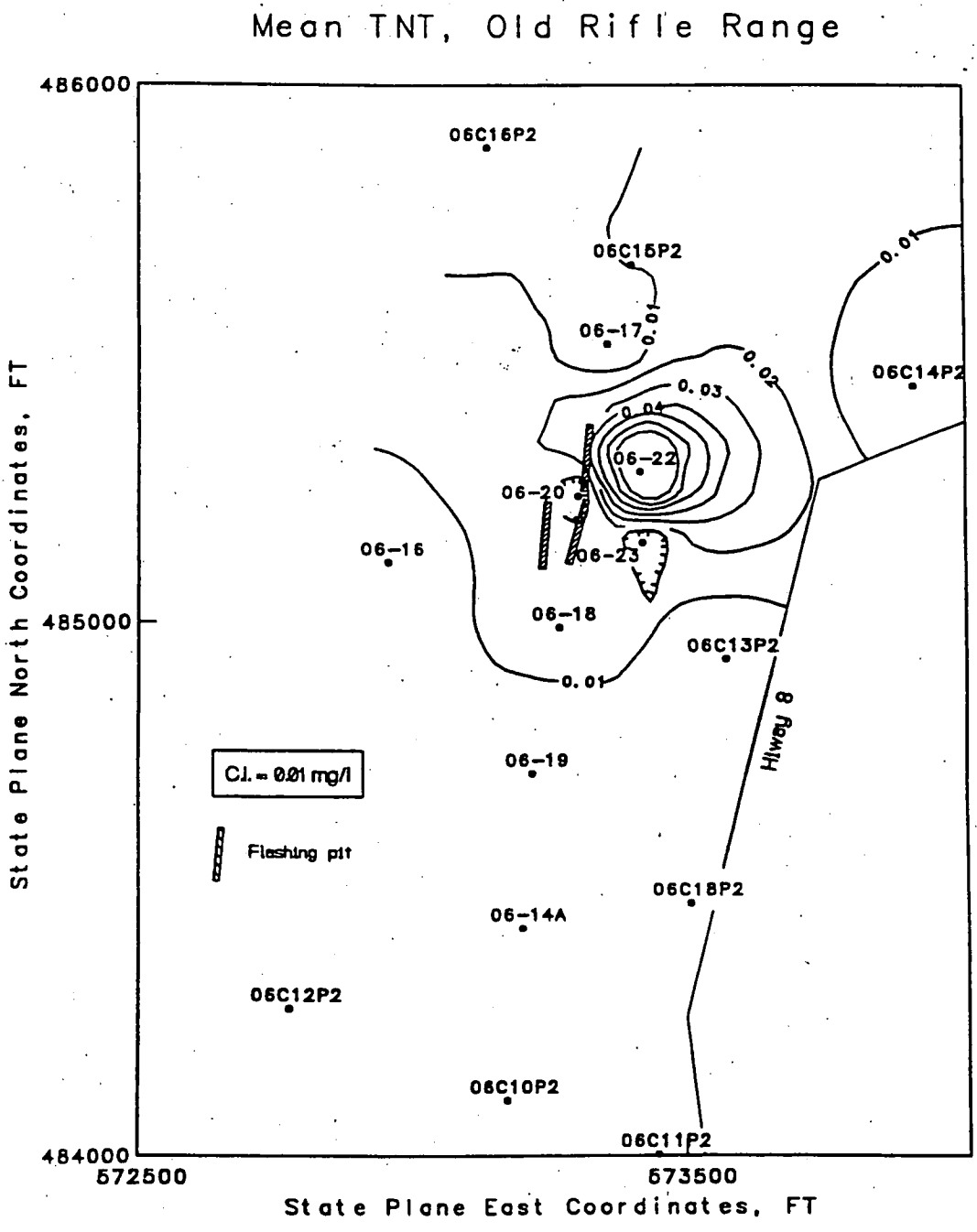


Figure 67. Mean values of TNT (four rounds), Old Rifle Range.

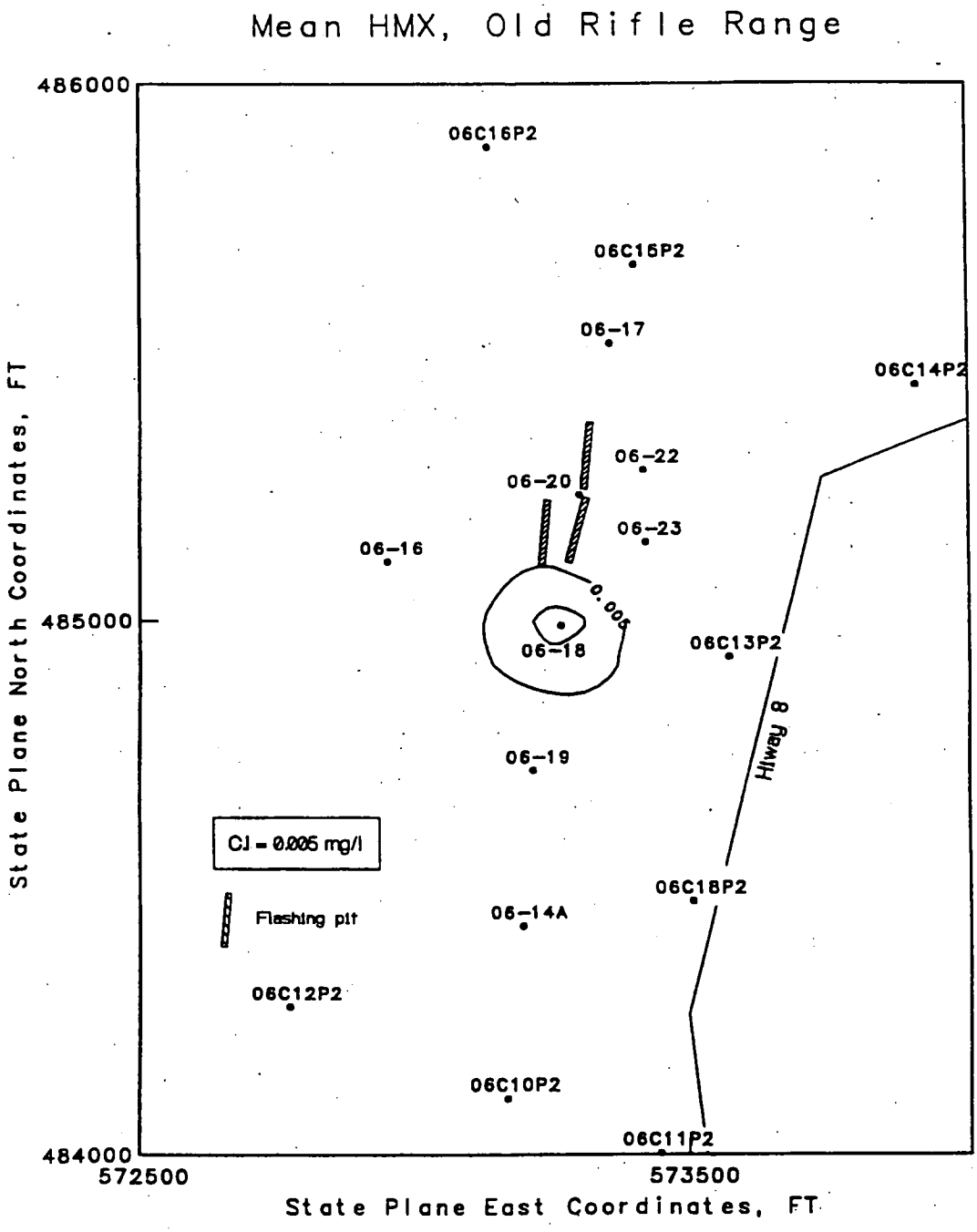


Figure ~~68~~ 81 Mean values of HMX (four rounds), Old Rifle Range.

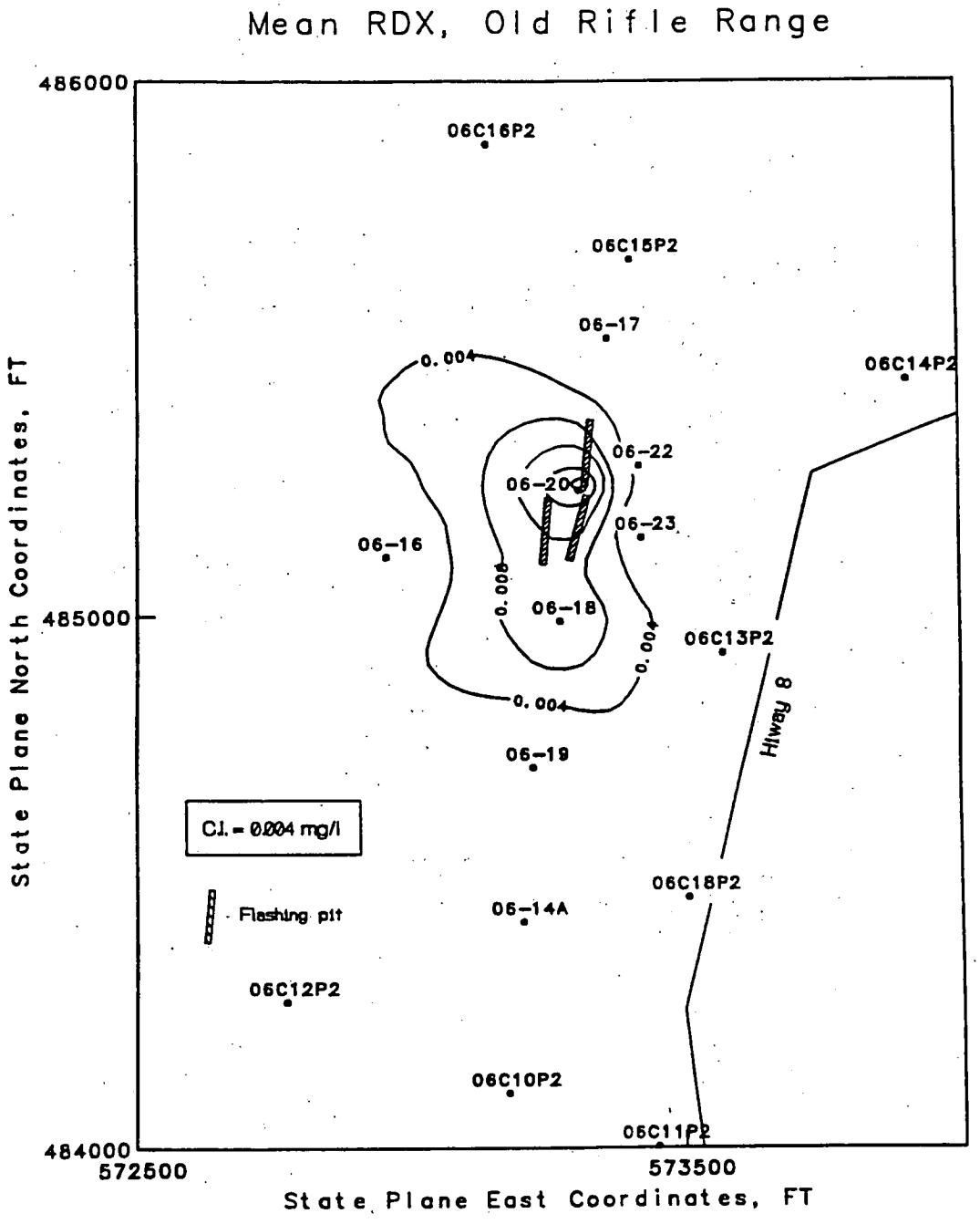


Figure 69. Mean values of RDX (four rounds), Old Rifle Range.

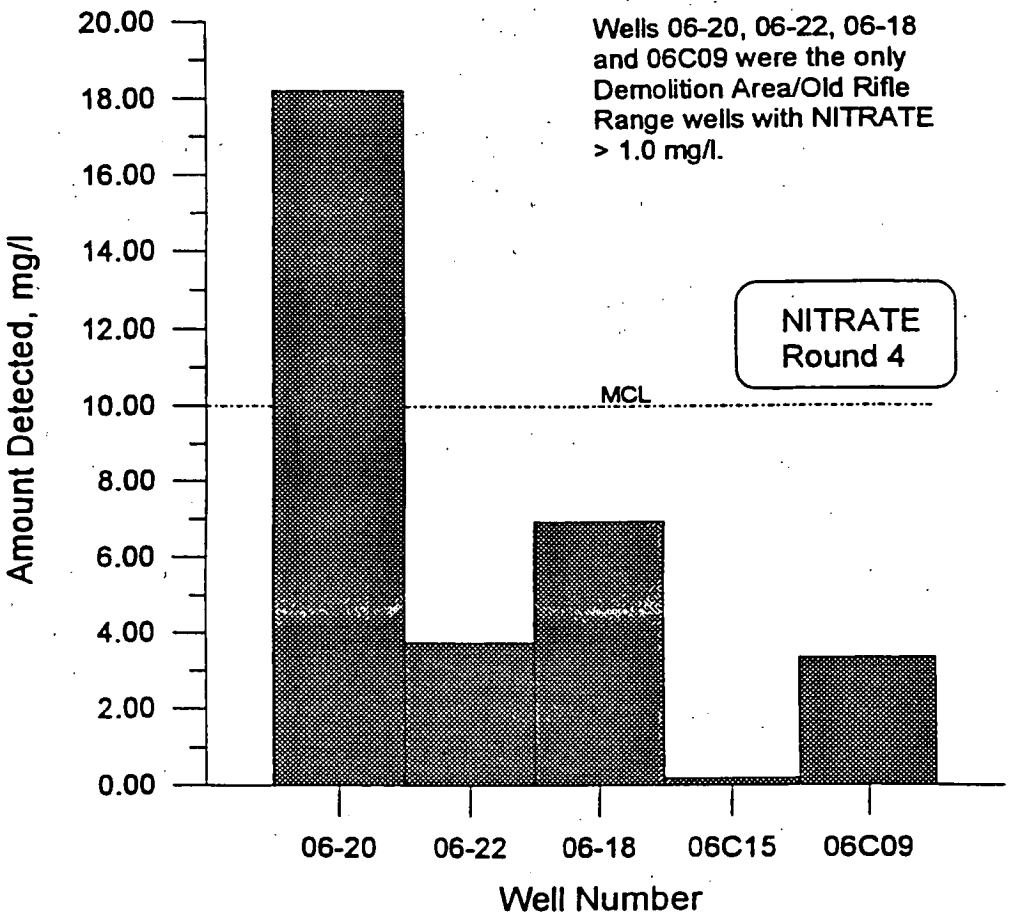


Figure ~~70~~ 83. Levels of nitrates in Old Rifle Range wells (fourth round only).

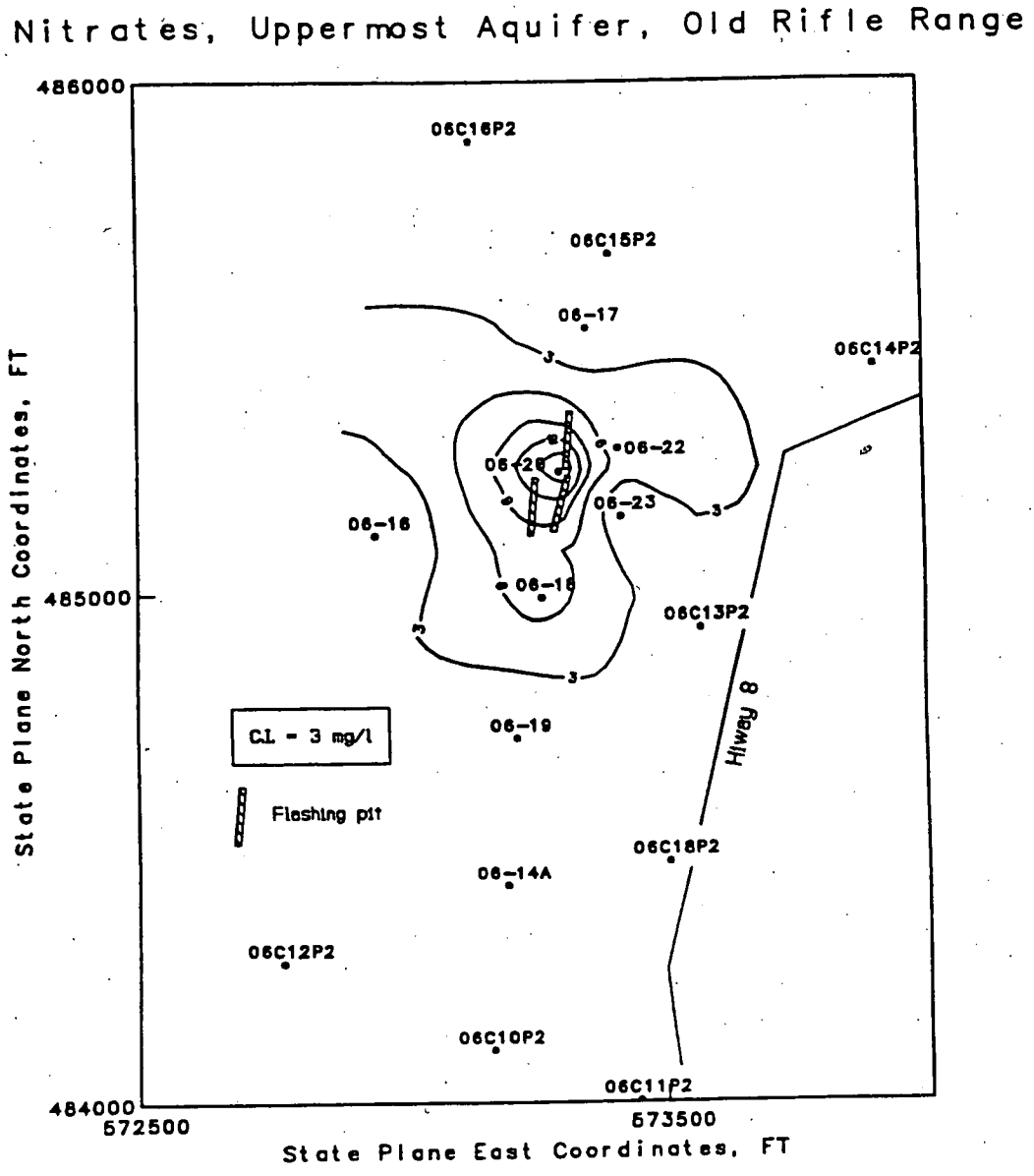


Figure 71. Levels of nitrates of at least 3 mg/l, Old Rifle Range (fourth round).

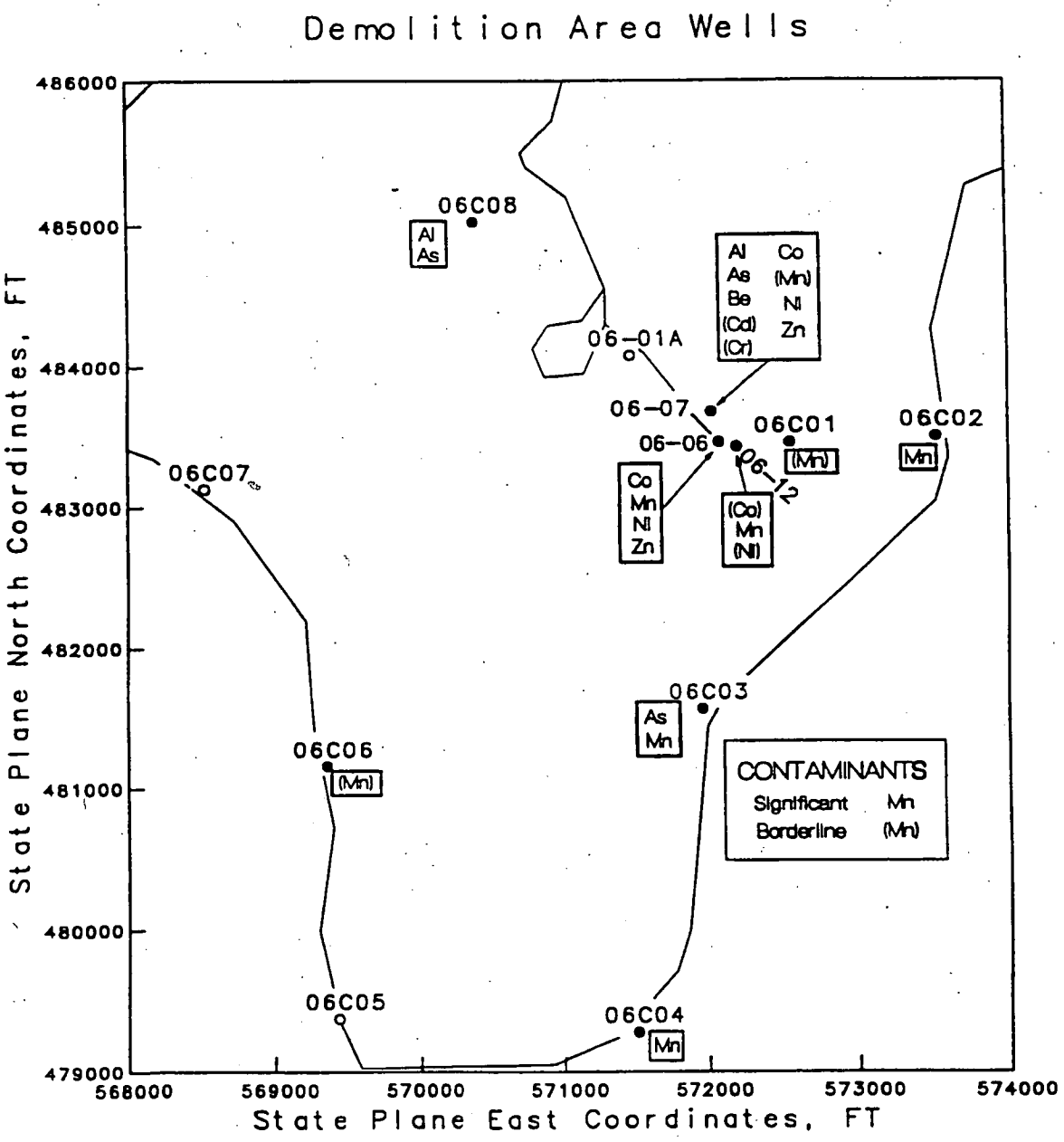


Figure 7~~2~~85. Statistically significant and borderline significant contaminants in Demolition Area wells.

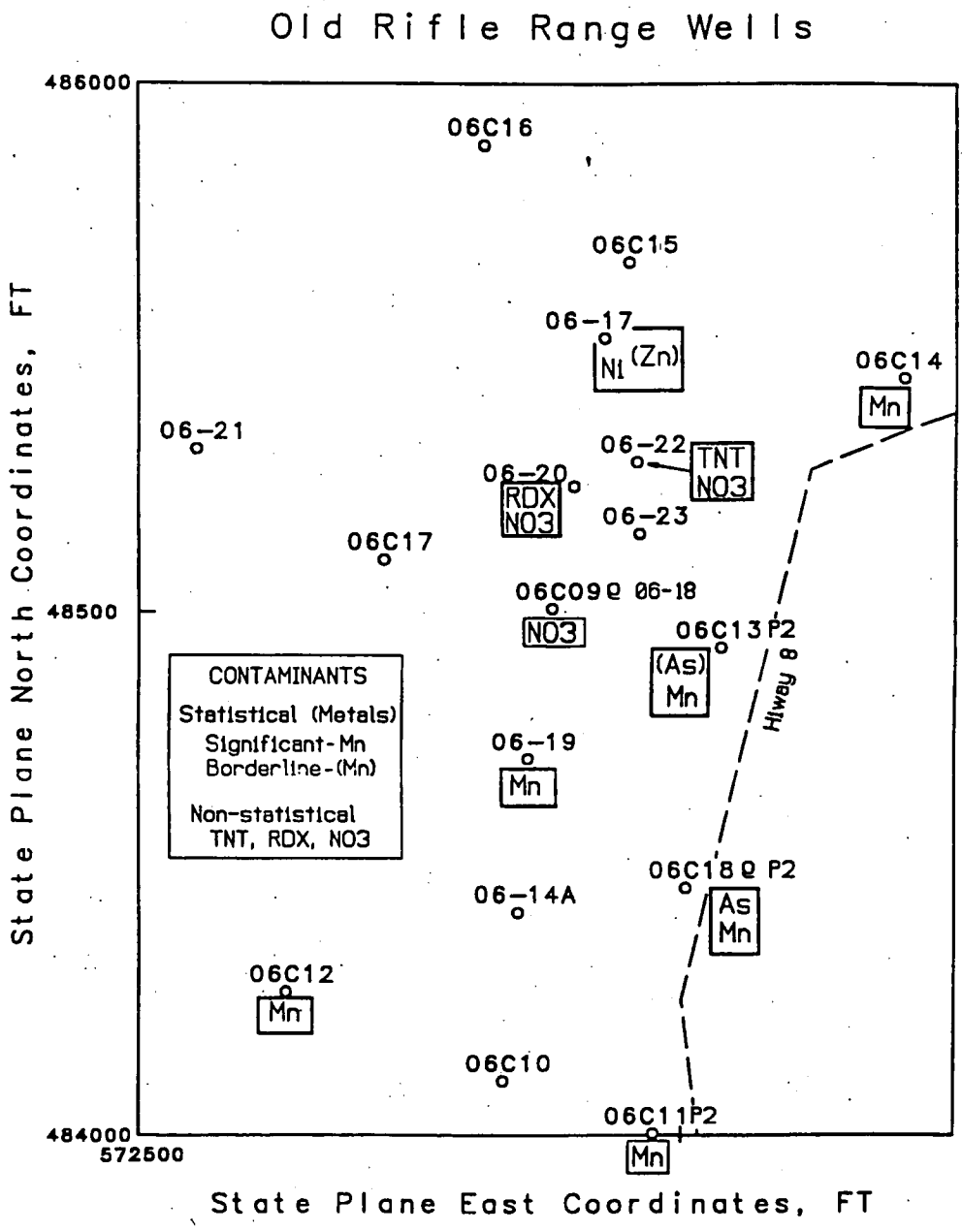


Figure 86. Statistically significant and borderline significant, and non-statistical contaminants in Old Rifle Range wells. Results of four rounds of sampling. Explosives shown only for wells with amounts > detection limit.

APPENDIX 6-1

STANDARD OPERATING PROCEDURE

GROUND WATER CONTOUR MAPS AND FLOW RATES

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1.0 PURPOSE

The purpose of this procedure is to provide a basic understanding of developing contour maps and the approaches used to identify and quantify the direction and rate of groundwater flow and contaminant plume movement.

2.0 SCOPE

This procedure provides only a general overview of the field techniques, mathematical and physical relationships and data handling procedures used for determining groundwater flow direction and rate. The references identified herein can provide a more complete explanation of particular methods cited, as well as a more comprehensive discussion on the interpretation of hydrogeologic data.

3.0 GLOSSARY

Aquifer - A geologic formation capable of transmitting usable quantities of groundwater to a well or other discharge point.

Aquitard - A geologic formation which retards the flow of groundwater due to its low permeability.

Confined Aquifer - An aquifer that is overlain and underlain by zones of lower permeability (aquitards). If the aquifer is "artesian," the potentiometric head of the aquifer at a given point is higher than the top of the zone comprising the aquifer at that point.

Equipotential Line - A line connecting points of equal elevation of the water table or potentiometric surface. Equipotential lines on the water table are also called water table contour lines.

Flow Line - A flow line indicates the direction of groundwater movement within the saturated zone. Flow lines are drawn perpendicular to equipotential lines.

Flow Net - A diagram of groundwater flow showing flow lines and equipotential lines.

Hydraulic Conductivity (K) - A parameter relating the volume of fluid flowing through a cross-sectional area of a saturated permeable medium to the driving force for the flow (hydraulic gradient). The hydraulic conductivity is a function both of the aquifer characteristics (porosity and interconnection of pores) and of the characteristics of the fluid (density and viscosity) passing through the aquifer. Thus, an aquifer will have a different hydraulic conductivity for water compared to pure-phase organic liquids.

Hydraulic Gradient (i) - The rate of change of hydraulic head per unit distance of flow at a given point and in the downgradient direction.

Hydraulic Head - The height to which water will rise inside a well casing, equal to the elevation head plus the pressure head. In a well screened across the water table, hydraulic head equals the elevation head, as the pressure head equals 0. In wells screened below the water table in an unconfined aquifer or screened at any interval within a confined aquifer, the head is the sum of the elevation of the aquifer (the elevation head) and the fluid pressure of the water confined in the aquifer (the pressure head).

Permeability - The capacity of a porous medium to transmit water. The degree of permeability depends on the size and shape of the pores, and the extent of their interconnections.

Porosity - Percentage of the total volume of a rock or soil which is occupied by voids (pore space).

Potentiometric (piezometric) Surface - A hypothetical surface that coincides with the static level of the water in aquifer (i.e., the maximum elevation to which water will rise in a well or piezometer penetrating the aquifer). The term "potentiometric surface" is usually applied to confined aquifers, although the water table is the potentiometric surface of an unconfined aquifer.

Unconfined Aquifer - An aquifer in which the water table forms the upper boundary.

Water Table - The surface in the groundwater system at which the fluid pressure is equal to atmospheric pressure (i.e., the net pressure head is zero) and below which all strata are saturated with water.

4.0 RESPONSIBILITIES

Project Hydrogeologist - The project hydrogeologist has overall responsibility for obtaining water level measurements and developing groundwater contour maps. The hydrogeologist (with the concurrence of the Project Manager) shall specify the reference point from which water levels are measured (usually a specific point on the upper edge of the inner well casing), the number of data points needed and which wells shall be used for a contour map, and how many complete sets of water levels are required to adequately define groundwater flow directions (e.g., if there are seasonal variations).

Field Personnel - All supporting field personnel must have a basic familiarity with the equipment and procedures involved in obtaining water levels, and must be aware of any project-specific requirements.

5.0 PROCEDURES

5.1 Potentiometric Surface Mapping

5.1.1 Selection of Wells

All wells used to prepare a flow net in a plan or map view should represent the same hydrogeologic unit, be it aquifer or aquitard. All water level measurements used shall be collected on the same day, preferably within 2-3 hours. This is especially important when working in an area where groundwater levels are tidally influenced or influenced by pumping.

Before mapping, review the recorded water levels and monitoring-well construction data, site geology and topographic setting must be reviewed to ascertain that the wells are completed in the same hydrogeologic unit and to determine if strong vertical hydraulic gradients may be present. Such conditions will be manifested by a pronounced correlation between well depth and water level, or by a difference in water level between two wells located near each other but set to different depths or having different screen lengths. Professional judgment of the hydrogeologist is important in this determination. If vertical gradients are significant, the data to be used must be limited vertically, and only wells finished in a chosen vertical zone of the hydrogeologic unit can be used.

At least three wells must be used to provide an estimation of the direction of groundwater flow; information from many more wells are needed to provide an accurate contour map. Generally, shallow systems require data from more wells than deep systems for accurate contour mapping.

5.1.2 Water Level Measurements

After selection of the wells to be used for mapping, the next step in determining the direction of groundwater flow is to obtain water level elevations from the selected points. In addition, any other readily available wells/surface water bodies should also be measured to ensure that sufficient data are available for interpretation purposes.

Elevations are obtained from measurements of the depth to water in a monitoring well or piezometer taken from the top of the well casing (see SOP GH-1.2) and then referencing the elevation of the casing to a chosen and consistent datum point, usually mean sea level. Subtracting the depth to water from the casing elevation provides the elevation of the potentiometric surface. Elevations of points and areas of groundwater discharge or recharge such as springs, seeps, streams, rivers, and lakes also need to be determined, typically through staff gauge measurements. Comparison of these elevations, which represent hydraulic heads, will reveal the direction of flow because groundwater flows from areas of high head to areas of low head.

5.1.3 Construction of Equipotential Lines

Graphical methods available for depicting the flow of groundwater include the use of equipotential lines and flow lines to construct potentiometric surface maps and vertical flow nets. If the hydrogeologic system consists of a water table aquifer and one or more confined aquifers, separate contour maps should be prepared for each aquifer system. Water table maps should be developed using water level measurements obtained from monitoring wells screened at the unsaturated-saturated interface. Water level measurements collected from monitoring wells screened in the deeper portions of an unconfined aquifer should generally be contoured as a separate potentiometric surface map. Surface water discharge or recharge features are contoured in the water table system. Vertical flow nets should be constructed using a cross section aligned parallel to the direction of groundwater flow. All water level measurements along this cross section, both deep and shallow, are used in developing equipotential lines and flow lines for the flow net.

To construct equipotential lines, water elevations in the chosen wells are plotted on a site map. Other hydrogeologic features associated with the zone of interest -- such as seeps, wetlands, and surface-water bodies -- should also be plotted along with their elevations.

The data should then be contoured, using mathematically valid and generally accepted techniques. Linear interpolation is the most commonly used technique. However, quadratic interpolation or any technique of trend-surface analysis or data smoothing is acceptable. Computer-generated contour maps may be useful for large data sets. Contour lines shall be drawn as smooth, continuous lines which never cross one another.

Inspect the contour map, noting known features, such as pumping wells and site topography. The contour lines must be adjusted utilizing the professional judgment of the hydrogeologist in accordance with these features. Closed contours should be avoided unless a known sink exists. Groundwater mounding is common under landfills and lagoons; if the data imply this, the feature must be evident in the contour plot.

5.1.4 Determination of Groundwater-Flow Direction

Flow lines shall be drawn so that they are perpendicular to equipotential lines. Flow lines will begin at high head elevations and end at low head elevations. Closed highs will be the source of additional flow lines. Closed depressions (i.e., wells) will be the termination of some flow lines. Care must be used in areas with significant vertical gradients to avoid erroneous conclusions concerning gradients and flow directions.

5.2 Groundwater Flow Considerations

Groundwater movement is an integral part of the hydrologic cycle. Recharge to the shallow groundwater environment generally occurs by infiltration of precipitation through an upper unsaturated soil zone. Movement is downward under the force of gravity until the water reaches the saturated zone of the water table aquifer. Once water is part of the water table aquifer, movement is controlled by differences in hydraulic head with movement from areas of high head to areas of low head. Areas of low head include natural discharge areas such as springs, lakes, rivers, and, ultimately, the ocean. These features can be considered as outcrops of the water table. Points of low head also are created by pumping wells.

Local head differences and consequent vertical flow patterns within an aquifer can be detected by well clusters. A well cluster consists of several adjacent wells, generally installed within a few feet of each other, and screened at different depths. Variations in water levels in these closely spaced wells indicates the vertical component of groundwater flow within an aquifer, provided that the wells are all screened within the same aquifer.

The number, location, and extent of geologic units and their properties with regard to aquifer or aquitard characteristics must be understood to properly interpret water level data gathered from the monitoring system. This firm understanding of the hydrogeologic system must be developed through a program of soil borings and interpretation of subsurface geology. The adequacy of the positions and depths of borings used to define relevant subsurface hydrogeologic conditions must also be assessed. The location of surface water discharge or recharge points must be considered. Surface water features influence the system, as flow is most likely toward them (if they are discharge points) or away from them (if they are recharge points). Man-made discharge or recharge features such as pumping or injection wells, ditches, and trenches can also affect the flow of groundwater.

5.3 Determination of Flow Rate

Darcy's Law states that the quantity of water flowing through a geologic material is dependent upon the permeability of the material, the hydraulic gradient, and the cross sectional area through which the water flows. This relation is expressed in the equation:

$$Q = KiA$$

where:

Q = volume of water flowing through the cross sectional area of the formation (L^3/T).
K = hydraulic conductivity (L/T).
i = hydraulic gradient (L/L, i.e., dimensionless).
A = cross sectional area of formation being considered (L^2).

The relation is similar to one used in stream flow measurements where:

$$Q = VA$$

where:

Q = discharge from the cross sectional area of a stream or pipe (L^3/T).
V = average velocity of flowing water (L/T).
A = cross sectional area through which water flows (L^2).

The velocity of water movement in a geologic formation depends on the specific formation properties and the head differences across the formation. This relation is defined in the equation:

$$V = \frac{K_I}{n}$$

where:

V = average linear velocity of groundwater through the formation (L/T)
K = hydraulic conductivity (L/T)
i = hydraulic gradient (dimensionless)
n = porosity (expressed as a fraction).

Values of porosity for several geologic materials are given in Attachment A. More accurate and specific values of porosity can be obtained by laboratory analysis of a formation sample.

Hydraulic conductivity is related to the permeability of the formation and depends on the size and interconnection of the pore spaces. In isotropic and homogeneous formations, the hydraulic conductivity will be the same vertically and horizontally. However, in anisotropic formations, horizontal and vertical conductivity can be markedly different and the vertical hydraulic conductivity can be up to several orders of magnitude lower than the horizontal hydraulic conductivity. For example, an unfractured shale has a very high porosity, but because of its layered nature, the pore spaces are not connected vertically. Consequently, unfractured shale often has a moderate horizontal hydraulic conductivity but a very low vertical hydraulic conductivity.

Generally, hydraulic conductivity is high for sands, gravels, and limestone containing large solution cavities and low for clays and tightly fractured rock. Attachment A gives values of hydraulic conductivity for several geologic materials. More accurate values can be obtained during field testing of aquifers or from laboratory measurements on undisturbed cores. However, results from field testing usually indicate higher hydraulic conductivities than laboratory testing because full-scale

field testing includes the effects of the formational macrostructure (i.e., secondary permeability due to jointing or fractures) which is not reflected in the testing of a small sample in the laboratory.

The hydraulic gradient, i, is determined from field measurements of hydraulic head obtained from water level measuring points. Do not measure gradient from well to well; measure across equipotential lines that are based on the well (and other) data. Once a potentiometric surface map has been generated using the hydraulic head data, the hydraulic gradient can be calculated using the following formula:

$$i = \frac{dh}{dl}$$

where:

dh = change in head (L)
dl = distance between equipotential lines (L)

The hydraulic gradient along any flow line can be calculated from a potentiometric surface map by dividing the contour interval by the length of the flow line between contour lines.

When chemical solutes are traveling in groundwater, as in cases of groundwater contamination, the calculated groundwater velocity may predict flow rates in excess of what is actually observed. This difference in chemical versus water velocities may be due to attenuation or biodegradation of the chemical species in the aquifer. Attenuation is most often caused by adsorption of the chemical contaminant onto the formation grains or matrix. The result is that the chemical does not appear at the downgradient sampling point as quickly as the velocity calculation predicts. An equation to correct for this attenuation is:

$$V_c = V_w/(1 + K_d P_b/n)$$

where:

V_c = velocity of the chemical solute flow (L/T)
V_w = velocity of groundwater flow (L/T)
P_b = formation mass bulk density (M/L^3)
n = formation porosity (expressed as a fraction)
K_d = distribution coefficient = (L^3/M)

The K_d is equal to the mass of solute per unit mass of solid phase divided by the concentration of solute in solution. The term in the denominator is known as the retardation factor.

Density differences between water and contaminants can also cause velocity determination errors. Light hydrocarbons such as gasoline are less dense than water and consequently float on the water table. These contaminants can migrate along the water table surface at rates faster or slower than the rate of groundwater movement, depending on specific conditions, and may also volatilize into unsaturated soil pore spaces. On the other hand, contaminants denser than water such as heavy hydrocarbons (e.g., coal tar) or chlorinated compounds (e.g., TCE, PCE) tend to sink to the bottom of an aquifer if present in concentrations exceeding their solubility limit. Here, the contamination may move at faster or slower rates than the overlying groundwater or may actually move in a

direction opposite to that of the groundwater, depending on the geologic characteristics of the aquifer base and direction of dip of the underlying aquitard.

Other factors involving the physicochemical interaction between the chemical and the groundwater, such as dilution (mixing contaminated water or chemicals with additional quantities of groundwater) and dispersion (molecular diffusion of the chemical throughout the groundwater regime), can also affect the observed rates of travel of contaminants in groundwater. In addition to such physicochemical characteristics, all of the aquifer and aquitard properties and groundwater flow characteristics described above must be known so that adequate and accurate estimations of the extent and severity of groundwater contamination can be developed.

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ATTACHMENT A

GENERALIZED POROSITY AND HYDRAULIC CONDUCTIVITY VALUES FOR GEOLOGIC MATERIALS

Material	Porosity Range (%)	Hydraulic Conductivity Range	
		cm/sec	ft/day
Gravel	30-40	10^{-1} to 10^{-2}	280 to 2.8×10^{6}
Coarse sand (clean)	30-40	10^{-1} to 1	280 to 2,800
Medium sand (clean)	35-45	10^{-2} to 10^{-1}	28 to 280
Fine sand (clean)	40-50	5×10^{-4} to 10^{-2}	1.4 to 28
Silty sand	25-40	10^{-5} to 10^{-2}	0.03 to 280
Glacial Till	Variable	10^{-10} to 10^{-4}	3×10^{-7} to 0.3
Unweathered Clay/Shale	45-55 (clay)	10^{-7} to 10^{-4}	3×10^{-4} to 0.3 (horizontal)
		10^{-10} to 10^{-6}	3×10^{-7} to 3×10^{-3} (vertical)
Karst Limestone	---	10^{-4} to 10^{-1}	0.3 to 2,800
Fractured Igneous/ Metamorphic Rocks	---	10^{-6} to 10^{-1}	3×10^{-3} to 280
Sandstone	5-30	10^{-8} to 10^{-4}	3×10^{-5} to 0.3

Source: References 1 and 2

APPENDIX 7-1

HYDROGEOLOGIC AND GEOCHEMICAL ASSESSMENT OF POROUS MEDIA AND KARSTIC FLOW REGIME OF THE BEECH CREEK AQUIFER, AMMUNITION BURNING GROUND

HYDROGEOLOGIC AND GEOCHEMICAL ASSESSMENT OF THE POROUS MEDIA AND KARSTIC FLOW REGIMES OF THE BEECH CREEK AQUIFER, AMMUNITION BURNING GROUNDS, NAVAL SURFACE WARFARE CENTER, CRANE, INDIANA

BY

STEVEN J. BAEDKE

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in partial fulfillment of the requirements
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Indiana University

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Foremost on my list, is my wonderful family. My parents, brother, sister, and sister-in-law; you have waited patiently and have been supportive for many years as I have finished my formal education. I can never repay the this.

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"And so it begins...."

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OVERVIEW

The results of previous studies and the proximity of the Ammunition Burning Grounds (ABG) to the boundary of the Naval Surface Warfare Center (NSWC), Crane, along with the possibility that contamination may move away from the NSWC via karst pathways, have alerted officials at the NSWC that ABG activities may have contaminated groundwater the area. Additionally, Crane officials are concerned that movement of contamination in the groundwater system may be impacted and enhanced by local karst features. In response to these concerns, this study attempts to evaluate: 1) the probability of contamination of the groundwater system at the ABG, and 2) determine potential pathways of groundwater movement in the subsurface (Chapter 1).

There are three aquifers in the vicinity of the ABG. From highest to lowest they are: 1) the Golconda -Haney aquifer, 2) the Beech Creek aquifer, and 3) the Beaver Bend aquifer. This study has integrated both physical and chemical hydrologic investigations to assess each aquifers potential to being contaminated. These techniques include: 1) potentiometric surface contouring, 2) dye tracing experiments, 3) hydrograph analysis of karst springs, 4) contaminant plume identification via contouring groundwater chemistries, 5) prevalent chemical character calculations, 6) chemical speciation modeling, and 7) chemical reaction path modeling. With these techniques, this study suggests that the Golconda - Haney and Beaver Bend aquifers are not presently contaminated and are not in immediate danger of becoming contaminated. The Beech Creek aquifer, however, appears to have been contaminated at some time in the past, and is still currently contaminated (Chapter 2).

The Beech Creek aquifer is karstic in nature and therefore poses a significant threat to contaminate locations that are hydrologically connected to the karst system. A tracer experiment conducted for this project suggests that the karst system originating in the ABG is confined to the NSWC property. However, the subsurface karst system does become surface water by issuing from a complex of springs (Spring A and A′) in the Little Sulphur Creek valley. After discharging from these springs, this water mixes with water in the Little Sulphur Creek and is then transported off of NSWC property to the south. If contaminants are also being discharged from these springs, they too have the potential of moving off of NSWC property (Chapter 3).

This study also suggests that it is possible to obtain meaningful hydrologic parameters from the analysis of karst-related spring hydrographs. When used in connection with dye tracing and pump test results, it appears that reasonable values of transmissivity and storativity can be obtained for the karst conduit system, the diffuse system, and the mixed flow system. These parameters may then be incorporated into physical flow and chemical transport models of the Beech Creek aquifer in the ABG. Results from such models will be useful in determining the effectiveness of any planned remedial action for the study area (Chapter 4).

CHAPTER 1

INTRODUCTION

Groundwater Studies in Karst Terrains

Groundwater studies in karst terrains have recently become a subject of intense study due, in part, to the dichotomy of flow characteristics between the rock matrix and conduit systems and the high risk of migration of contaminated groundwater in karst areas. These tasks, however, have proven to be very difficult, expensive, and time consuming and have ended in varying degrees of success. This is primarily due to the difficulty in determining meaningful hydrologic parameters in karst terrains where such measurements are rare and display considerable variation. For instance, the effective primary porosity of a carbonate aquifer is generally considered to be negligible. However, where the aquifer possesses fissures in the rock and/or solutionally enlarged conduits, values of secondary and tertiary porosity are very large. As a result, karst aquifers show both temporal and spatial variation between diffuse-type and conduit-type groundwater flow (in other words, movement of water through the rock matrix vs. conduits). The "duality" of hydrologic properties in karst aquifers makes it very difficult to quantify the movement of groundwater through and/or between different aquifers or parts of a single aquifer.

In addition to showing great variability, the identification of hydrologic parameters in karst aquifers is further complicated by incorrect techniques for data collection and/or interpretation. Field methods such as pumping, injection, packer and slug tests that are used to determine hydrologic properties over an extended thickness of an aquifer may be applicable for porous media (i.e. diffuse-type flow system). However, methods that concentrate on collecting data from wells rarely, if ever, provide estimates of the properties for the conduits. Even in the rare case where a

conduit is either penetrated by, or is next to, the well being tested, the hydrologic properties derived from the well test can only be applied to the area immediately around the well. This is because few conduits are actually interconnected (Tsang, 1997, estimates about 80% of all fractures are not hydrologically connected to other fractures) and spatial variation in aperture size of the conduit varies greatly at a regional and local scales. Therefore, appropriate field methods must be used to collected aquifer data from the conduit-type flow systems as well.

This dissertation will attempt to evaluate the connection between karstic and non-karstic aquifers as well as evaluate the connection between the karstic and non-karstic parts of a single aquifer.

Background to the Present Research and Dissertation Organization

This study was initially funded by a grant awarded in 1993 from the U.S. Army Corps of Engineers Waterways Experiment Station (WES) under its Broad Agency Announcement (Contract No. DACA 39-93-K-0051). The purpose of this study was divided into two tasks: 1) to provide discharge and chemistry data for surface waters and springs in the Ammunition Burning Grounds (ABG) watershed, and 2) to analyze groundwater chemistry data and develop hydrochemical reaction path models to help determine pathways of groundwater movement in the subsurface. Results from the surface- and spring-water chemistry portion of the study can be found in a preliminary report submitted to the WES (Krothe and Baedke, 1994) and two Indiana University Masters Thesis' prepared by Cohen (1996) and Noriega (1997). Preliminary groundwater chemistry and geochemical modeling results were also delivered in the WES report (Krothe and Baedke, 1994). An expanded discussion of this work is incorporated into this dissertation (Chapter 2).

The Naval Weapons Support Center (NSWC) granted another contract to the Department of Geological Sciences through the WES in 1996 to further investigate pathways of contaminant transport, and surface and groundwater movement in the area (Contract No. DACW39-96-K-0004). Three studies have been undertaken to help direct future groundwater monitoring, remediation, and contaminant flow/transport modeling at the ABG: 1) an Indiana University Masters Thesis prepared by DiGnazio (1997) investigated the source of nitrate groundwater contamination in the ABG using isotopes of nitrogen (results will not be reproduced here) , 2) a quantitative dye trace of the karstic Beech Creek - Big Clifty aquifer (Chapter 3), and 3) effective hydraulic parameters for the karstic Beech Creek - Big Clifty aquifer have been calculated using discharge hydrograph analysis method (Chapter 4).

History of Operations and Previous Studies at the Ammunition Burning Grounds

The ABG has been used since the 1940's for the destruction of materials contaminated with explosives, bare explosives, rocket motors, candles, flares, solvents, red phosphorus, small detonators and fuse materials (Murphy, 1994). The largest amount of materials were destroyed from 1956 to 1960, when 15,000 lbs. per day of powder and 48,000 lbs. per day of high explosives were burned (Murphy, 1994).

Due to the presence of four surface impoundments (dewatering beds) at the ABG and the potential for release of contaminants from these structures, a groundwater monitoring program was initiated in 1981 and the US Army Corps of Engineers Waterways Experiment Station (WES) was contracted by Crane to install monitoring wells at the ABG. In 1982 the results of the monitoring program suggested the presence of groundwater contamination at the ABG. In 1983, an Initial

Assessment Study by the Naval Energy and Environmental Support Agency, the Ordnance and Environmental Support Agency, and the WES, identified the ABG as a site requiring investigation because of past hazardous waste disposal. Groundwater monitoring continues at the present time.

In 1986-1987, the WES conducted a hydrogeological investigation of the ABG and surrounding area. Sixty-six exploration and monitoring wells in three aquifers and hydrogeologic mapping identified several factors that may influence groundwater flow into and out of the ABG. The report (Hunt, 1988) suggested that groundwater flow:

> *"is primarily through rock joints. Rock joints in the Beech Creek aquifer have been enlarged by solution locally within the study area. Flow through those zones (described as 'solution passages') can be rapid. Solution passage groundwater flow is believed to be the principle component of the subsurface hydrology with the ABG area".*

Following recommendations from the Hunt report, the WES conducted a dye trace of the Beech Creek aquifer to determine pathways of groundwater flow. The results (Murphy and Ciocco, 1990) indicated that the ABG is in hydrologic connection with the karstic conduits in the Beech Creek aquifer. Additionally, two karst springs were determined to be the primary outlets for the conduit system and that since these springs feed into a surface water stream there is a potential for the contamination could move off-site. An elaboration of this work are incorporated into Chapter 4 of this document.

From 1992 to 1994, the Indiana Geological Survey compiled detailed surface and subsurface geological maps of several areas at Crane, including the ABG. The Indiana University Hydrogeology Laboratory (Dept. of Geological Sciences) received funding in 1993-1994 and began efforts to more fully characterize and understand the karst system at the ABG and to help

assess the potential of contaminant release and/or movement through these pathways. The Hydrogeology Lab was again funded in 1996 to continue this line of research, which is ongoing at the present time.

CHAPTER 2. HYDROGEOLOGY AND GEOCHEMISTRY OF AQUIFERS BENEATH THE AMMUNITION BURNING GROUNDS, NAVAL SURFACE WARFARE CENTER, CRANE, INDIANA.

Abstract

There are three aquifer at the Ammunition Burning Grounds (ABG), Naval Surface Warfare Center (NSWC), Crane, Indiana. From highest to lowest these aquifers are the Golconda - Haney, the Beech Creek, and the Beaver Bend aquifers. The Beech Creek aquifer is known to be contaminated by disposal practices at the ABG. In order to minimize the impact of the contaminants in the groundwater system at the ABG, it is important to understand the potential pathways of groundwater movement into and out of the Beech Creek aquifer.

This part of the study integrates both physical and chemical hydrologic properties of the three aquifers to assess each aquifers potential to being contaminated. The techniques employed include: 1) potentiometric surface contouring, 2) contaminant plume identification via contouring groundwater chemistries, 3) prevalent chemical character calculations, 4) chemical speciation modeling, and 5) chemical reaction path modeling.

Using these techniques, this study has found that there is little potential that the either the Golconda - Haney or Beaver Bend aquifers are presently contaminated, or are likely to be contaminated, by current practices in the ABG. Therefore, these aquifers have not been studied in the same detail as the Beech Creek aquifer.

The Beech Creek aquifer, however, is believed to be contaminated by operations at the ABG, for instance plumes of Mg^{2+} and SO_4^- have been identified in the Beech Creek aquifer.

Geochemical modeling has established that the observed concentrations of Mg^{2+} and SO_4^- cannot be produced by interactions with geologically available materials. The Mg^{2+} and SO_4^- contamination in the aquifer is effecting the natural groundwater chemistry of the Beech Creek.

The configuration of Mg^{2+} and SO_4^- plumes shows that the origin of these constituents is the area burning in the ABG and that the contaminants have been transported in the direction of groundwater flow in the Beech Creek aquifer. Groundwater flow, and therefore contaminant transport, in the ABG is toward a known karstified portion of the aquifer. If contaminants enter this karst system, they may potentially be transported to downgradient outlets and then offbase. The hydrologic connection between this karst system and the non-karstic portions of the Beech Creek aquifer will be examined in detail in Chapters 3 and 4 of this study.

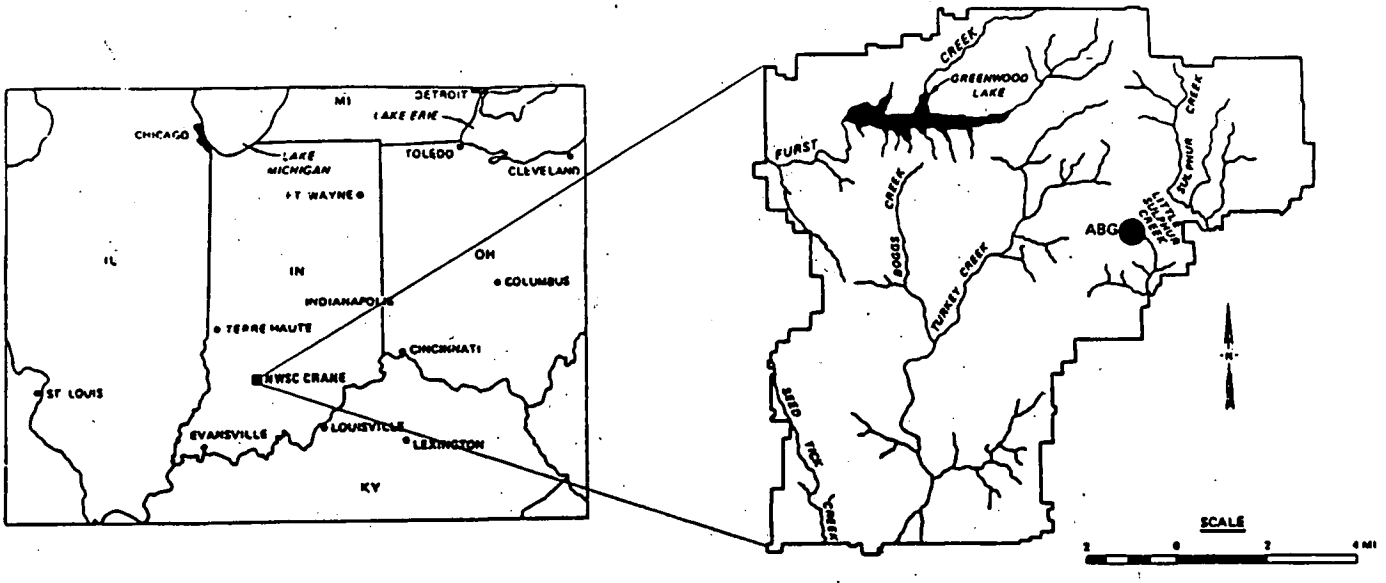


Figure 2.1: Location of the NSWC in Indiana (left). Location of the ABG within the NSWC (right).

Study Area: Location

The NSWC is located in the northern portion of Martin County and small portions of Greene, Daviess, and Lawrence counties of southwest Indiana (Figure 2.1). The NSWC is approximately 100 square miles (62,463 acres) in size. The ABG lies in the eastern part of the NSWC (NW ¼ of Section 28 and the SW ¼ of Section 21, T5N, R3W) and is approximately 50 acres in size.

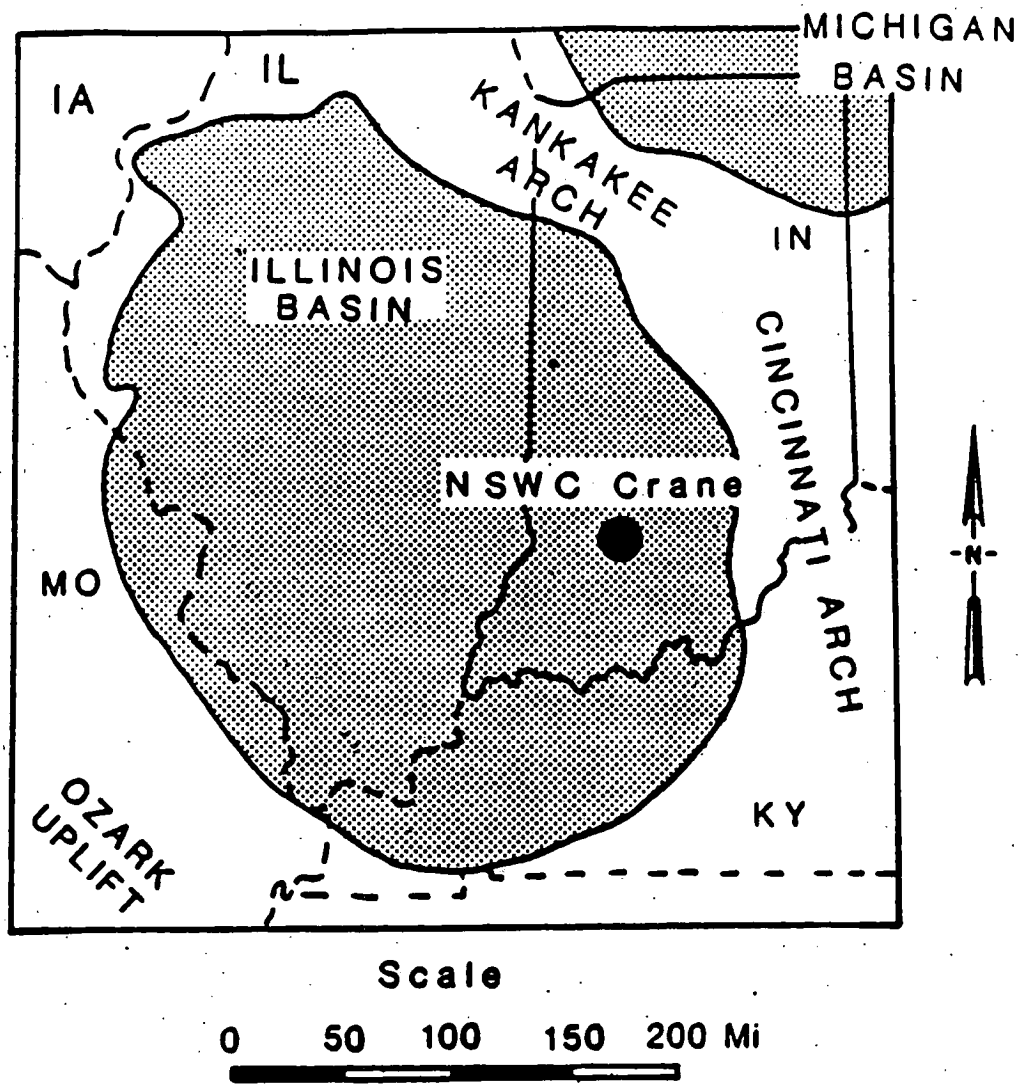


Figure 2.2. Location of Crane and some major structural elements of the mid-continent.

Study Area: Physiography and Geology

The NSWC is located in the southeastern part of the Illinois Basin and is bounded to the east by the Cincinnati Arch, to the northeast by the Kankakee Arch and Michigan Basin, and to the west by the Ozark Uplift (Figure 2.2). The ABG is about 2000 feet long by 1000 feet wide and lies near the head of the Little Sulphur Creek drainage. The topography of the study area is

rugged, consisting of a series of steep sided, arrow ridges and valleys that range in elevations range from 480 feet (above mean sea level) to 845 feet.

The geology of the ABG was first described by Hunt (1988), and subsequently by Kvale (1992), and Barnhill and Ambers (1994). The rocks in the ABG are of lower Pennsylvanian and upper Mississippian age. Pennsylvanian strata, comprised of predominately marine sandstones and shales, cap most of the hills and ridges in the study area. The Mississippian rocks, which are alternating sequences of limestones, shales, and sandstones, were deposited in shallow seas. The contact between the Pennsylvanian and Mississippian is a disconformable surface.

Starting at the ABG and moving down the Little Sulphur Creek drainage to the southern boundary of Crane, rocks of the Indian Springs Shale (20 ft. thick), the Big Clifty Sandstone (40 ft. thick), the Beech Creek Limestone (18-22 ft thick), and the shaley portion of the Elwren Formation (20 ft. thick) can be observed (youngest to oldest) (Murphy & Ciocco, 1990) (Figure 2.3). Surface water runoff and groundwater flow at the ABG are controlled by these rocks.

Drillers have encountered voids in the Beech Creek limestone that are indicative of solution cavities or buried karst features. Therefore, the relationship between the Big Clifty sandstone and Beech Creek limestone are of particular interest to this study.

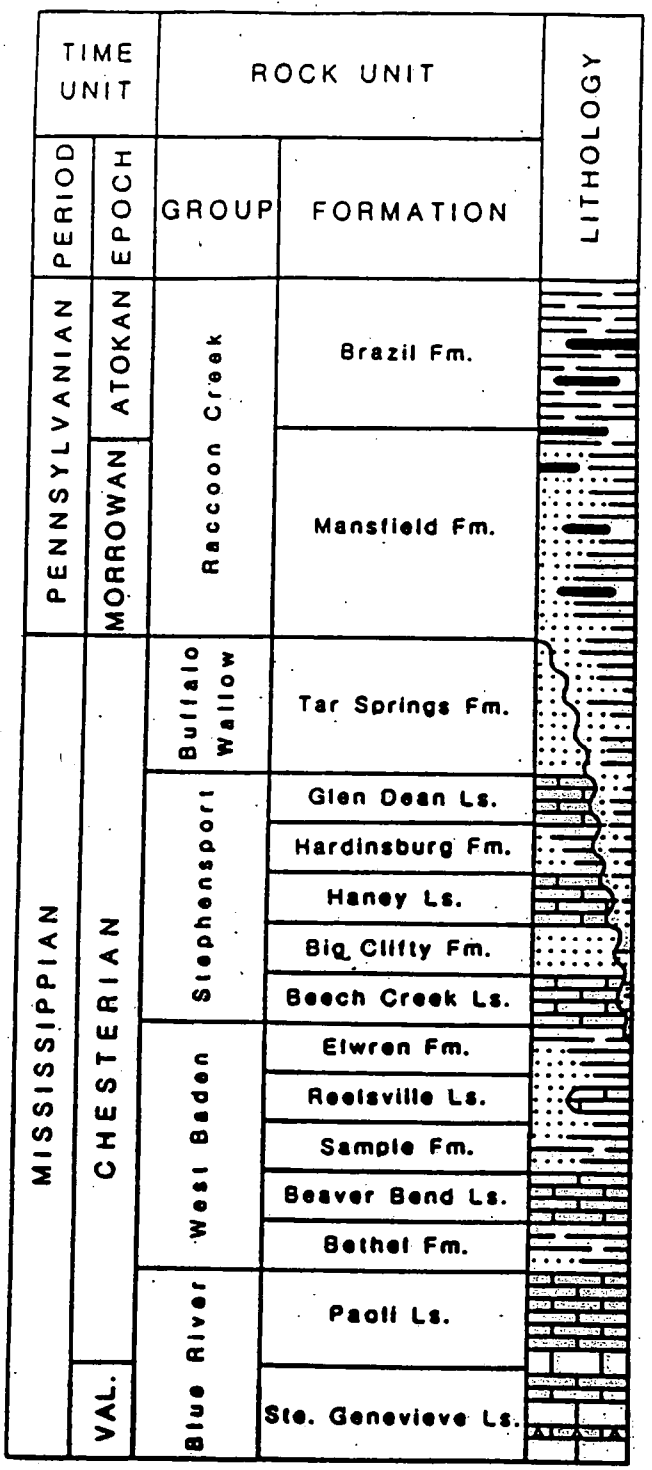


Figure 2.3. Stratigraphic section of the rocks in the study area.

Period	Formation/Rock Type (thickness)	General Hydrologic Character
Pennsylvanian	Mansfield / Sandstone (30 ft)	Upper Member of Golconda - Haney Aquifer
Pennsylvanian	Golconda- Haney / Limestone (15 ft.)	Lower Member of the Golconda - Haney Aquifer
Mississippian	Indian Spring / Shale (20 ft.)	Aquiclude
Mississippian	Big Clifty / Sandstone (40 ft)	Upper Member of Big Clifty / Beech Creek Aquifer
Mississippian	Beech Creek / Limestone (20 ft)	Lower Member of Big Clifty / Beech Creek Aquifer
Mississippian	Elwren / Shale (20 ft)	Aquiclude
Mississippian	Beaver Bend / Limestone (20 ft)	Beaver Bend Aquifer

Table 2.1 - General stratigraphy of the study area

Study Area: Hydrology and Geochemistry

Three aquifers have been identified in the study area. From highest to lowest they are; the Golconda - Haney, the Beech Creek, and the Beaver Bend aquifers (Table 2.1). As pointed out in Chapter 1, a primary goal of this study is to address the interrelationship and hydrologic connection between these aquifers.

More than 99% of the dissolved solids in natural groundwater are generally composed of less than a dozen constituents. The bulk of these consist of only seven ions - Ca^{2+} (calcium), Mg^{2+} (magnesium), Na^{+} (sodium), K^{+} (potassium), HCO_3^{-} (bicarbonate), $CO_3^{=}$ (carbonate), $SO_4^{=}$ (sulfate), and Cl^{-} (chloride) - and some dissolved SiO_2. Waters can be classified into groups, referred to as the prevalent chemical character, based on the this ion chemistry. Piper diagrams (Piper, 1944) are used to graphically represent prevalent chemical character. Changes in prevalent chemical character through time and between sites that may, or may not, be hydrologically

connected, can be used to gain an understanding of the origin and movement of groundwaters, and potential reactions taking place in or between aquifers.

The following sections contain descriptions of the physical and chemical hydrogeology of each aquifer. However, based upon the results of previous work at the ABG, officials at the NSWC have asked for an expanded study on the Beech Creek aquifer. In keeping with this request, properties of the Beech Creek aquifer be concentrated upon.

Golconda - Haney Aquifer

The Golconda - Haney aquifer consists of the Golconda and Haney limestones. The prevalent chemical character of groundwater from this aquifer is Ca^{2+} - HCO_3^- (Figure 2.4). Underlying the aquifer is the Indian Springs shale, which acts as an aquiclude. Water entering this aquifer moves laterally along its base and eventually exits the aquifer via seeps. Once at the ground surface, water enters the Beech Creek aquifer either by percolation through the Big Clifty sandstone or by entering the headwaters of the Little Sulphur Creek.

Since the Golconda-Haney aquifer is at a higher elevation than operations at the ABG, there is very little potential for it to be contaminated by ABG activities, therefore the Golconda-Haney aquifer is not of direct concern to this project.

Beech Creek Aquifer

The Beech Creek aquifer consists of the Big Clifty sandstone, the Beech Creek limestone, and the Elwren shale. While installing monitoring wells in this aquifer, drillers encountered numerous voids in the Beech Creek limestone that are believed to be solution cavities or buried

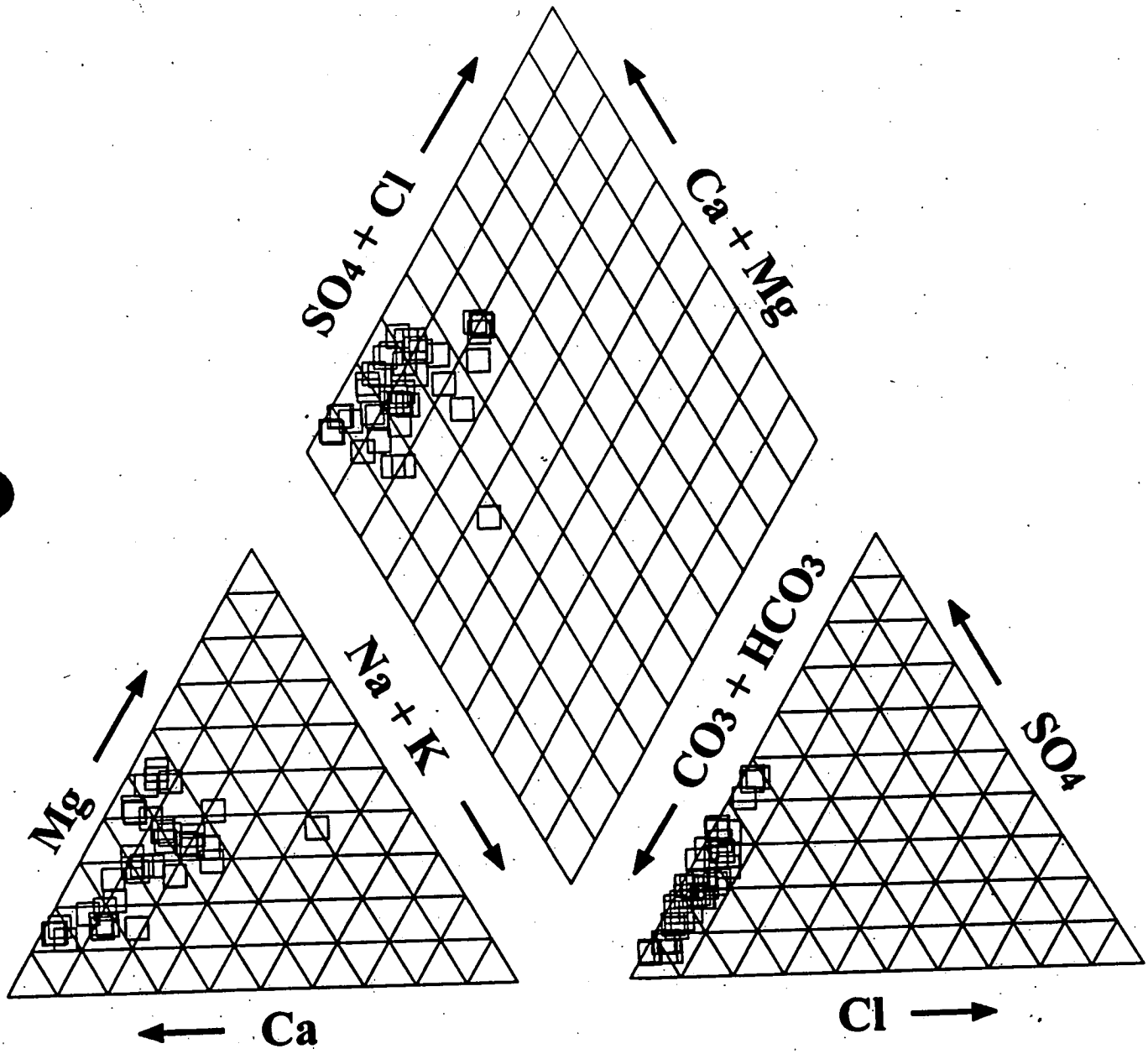


Figure 2.4. Piper diagram of water chemistry analysis taken from the Golconda-Haney aquifer.

karst features. In addition to being a karst forming unit in the study area, disposal operations at the ABG are performed directly on top of this aquifer. For these reasons, the Beech Creek is most likely impacted by operations at the ABG and therefore this aquifer is the main topic of this study.

The Beech Creek aquifer is partially open to recharge from surface water infiltration within the ABG during rainfall. Rainwater falling on the ABG drains into the headwaters of the Little Sulphur Creek. As surface water travels down the Little Sulphur Creek the Indian Springs shale pinches out and the Big Clifty sandstone comes to outcrop. Here, surface water percolates into the Big Clifty sandstone and the Little Sulphur Creek becomes an intermittent stream. Barnhill and Ambers (1994) observed an orthogonal fracture pattern in the rocks comprising this aquifer with primary joint directions trending east-west and north-south. It is believed that surface drainage is controlled by these fractures and that most surface drainage is captured by the Little Sulphur Creek.

After entering the Big Clifty sandstone groundwater moves vertically and horizontally by diffuse- and conduit-flow. Vertical groundwater movement allows recharge into the underlying Beech Creek limestone. Groundwater then enters the Beech Creek Limestone and moves through solution features, fractures, and along bedding planes. The Elwren Shale inhibits further vertical movement of groundwater and forces subsequent movement to be parallel to the contact between of the Elwren Shale and Beech Creek Limestone. Several springs emerge from the walls of Little Sulphur Creek at the contact between the Elwren Shale and Beech Creek limestone and are likely to be outlets from the Beech Creek karst system.

Unlike the Golconda-Haney and Beaver Bend aquifers, estimates of hydraulic properties exist for the Beech Creek aquifer. Barnhill and Ambers (1994) conducted permeability and porosity tests on core from the Big Clifty Sandstone and Beech Creek limestone. They found that the unfractured portion of the Big Clifty sandstone had an average permeability of 0.217 darcys ($2.14e^{-13}$ m^2) and an average porosity of 18.6%. The unfractured portion of Beech Creek limestone had an average permeabiltiy $1x10^{-6}$ darcys ($9.9e^{-19}$ m^2) and an average porosity of 1.67%. Murphy (1995) conducted pump tests on three wells in the Beech Creek aquifers and found that it to have an average permeability of 0.232 darcys ($2.3e^{-13}$ m^2). Keeping in mind that during pumping test the amount of water flowing horizontally to the well is much greater that water flowing vertically to, and that in layered aquifers the most of the flow is carried in the more conductive layer, it is not surprising that the permeability provided by the pumptests are in the same range as the permeability of the Big Clifty sandstone from the core analysis (a more detailed interpretation of the pumptest results are presented in Chapter 4).

Of primary concern to this study is the effect that karst related conduits have on the movement of groundwater from the operations area at the ABG. Murphy (1990) conducted a qualitative dye that established that the ABG was hydrologically connected to downgradient karst springs in the Little Sulphur Creek. Based upon the outcome of this study, the hydraulic conductivity of the conduit system in the vicinity of the ABG was estimated to be xxxx. This high value of conductivity implies that contamination entering the conduit system can migrate extreme distances in a short period of time. It is therefore important to know if contaminated groundwater is traveling toward karst related conduits in the Beech Creek.

Unlike a diffuse aquifer, flow in a karst aquifer will converge towards conduits and move rapidly to springs at the downstream end of the basin (Quinlin and Ewers, 1985; Domenico and Schwartz, 1990). Therefore, spatial variations in groundwater levels may show where focusing of groundwater is occurring, with the interpretation being made that the conduit-system is controlling the focusing. Water table maps, thus, may show areas impacted by karst conduits.

A debate over the existence of a true water table in karst aquifers has persisted throughout the history of karst research. German karst hydrologists were probably the first to embrace the existence of a single water table in karst terrains. Their French counterparts generally rejected this hypothesis and denied that a true water table existed. Researchers in the United States have, however, been more influenced by the work of the Germans and have adopted the concept of a water table in karst areas (White, 1988). Recently (in the last 10 years) it's become more widely accepted that a true water table can exist in karst terrains when carbonate rocks outcrop at the land surface or near enough to it to lie in the groundwater circulation system. However, where the rock is almost impermeable the water table may be locally discontinuous or completely absent (LeGrand and LaMoreaux, 1975).

In the vicinity of the ABG, the Beech Creek limestone outcrops at earths surface, so a water table map, prepared by contouring water levels observed in wells, may show where karst conduits exist. A map of the water table (Figure 2.5) shows a well developed potentiometric surface with a deep groundwater trough in the east-central part of the ABG (near well 03-C2P2) and a groundwater mound in the vicinity of well 03-C10. The mound marks the location of a groundwater divide that causes recharging groundwater to flow radially in all directions away from its center, indicating that this is an area of recharge to the aquifer. The trough marks the route of a

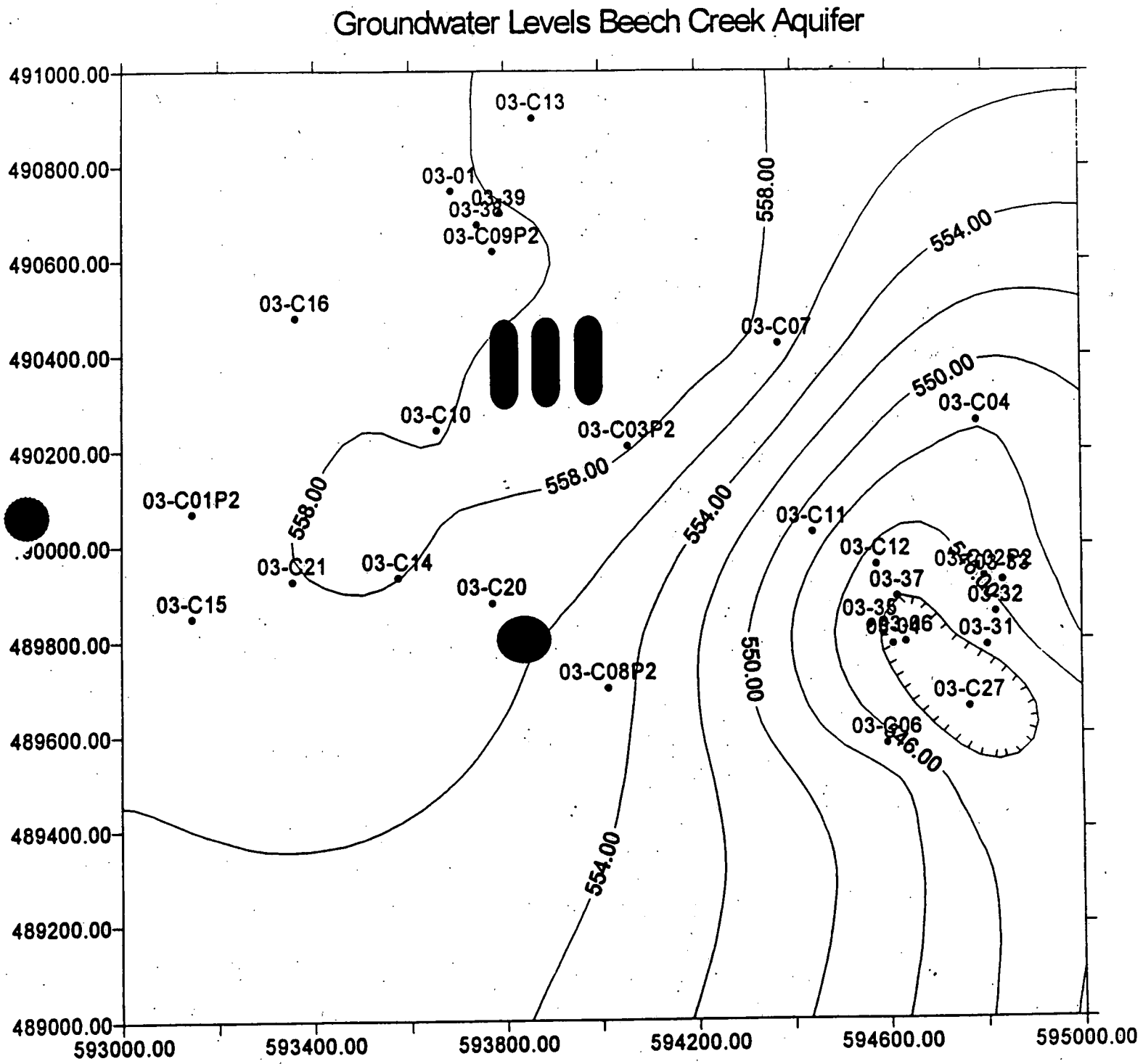


Figure 2.5. Contour map of the potentiometric surface in the Beech Creek aquifer in the vicinity of the ABG. Elongate ovals are the current locations disposal activities.

conduit system that is carrying subsurface flow from the ABG to downgradient outlets. Giddings (1974) and Quinlan and Ray (1981) made the same interpretation upon seeing similar features on water table maps from the Spring Creek Basin (central Pennsylvania) and the Sinkhole Plain south and east of Mammoth Cave National Park, respectively. Quinlan and Ray additionally showed that water table highs coincided with the boundaries of the groundwater basins that had been defined by extensive tracer experiments.

The implications of a groundwater mound and trough in the ABG is significant. The location of the groundwater mound (elevation approximately 558ft) coincides with the area where the burning of munitions have taken place, both historically and currently (elongate ovals on Figure 2.5). Therefore, any contamination entering the groundwater system from burning activities may migrate in all directions away from the ABG. If this scenario is true, remediation would potentially need to be applied in all downgradient locations from the groundwater mound. The existence of a deep groundwater trough (elevation 544 ft), has the potential of drawing large volumes of groundwater. Therefore any contaminants in the groundwater, from the area of burning toward the karst in the vicinity of well 03-C2P2. Further, the dye trace of Murphy (1994) and the dye trace undertaken for this project (Chapter 4), indicate that the karst connected with well 03-C2P2 will eventually discharge from downgradient springs in the valley of Little Sulphur Creek. These downgradient springs discharge to Little Sulphur Creek itself, which then carries surface water off-base to the south. If contaminants are also being discharged at these springs, they too will move off-base.

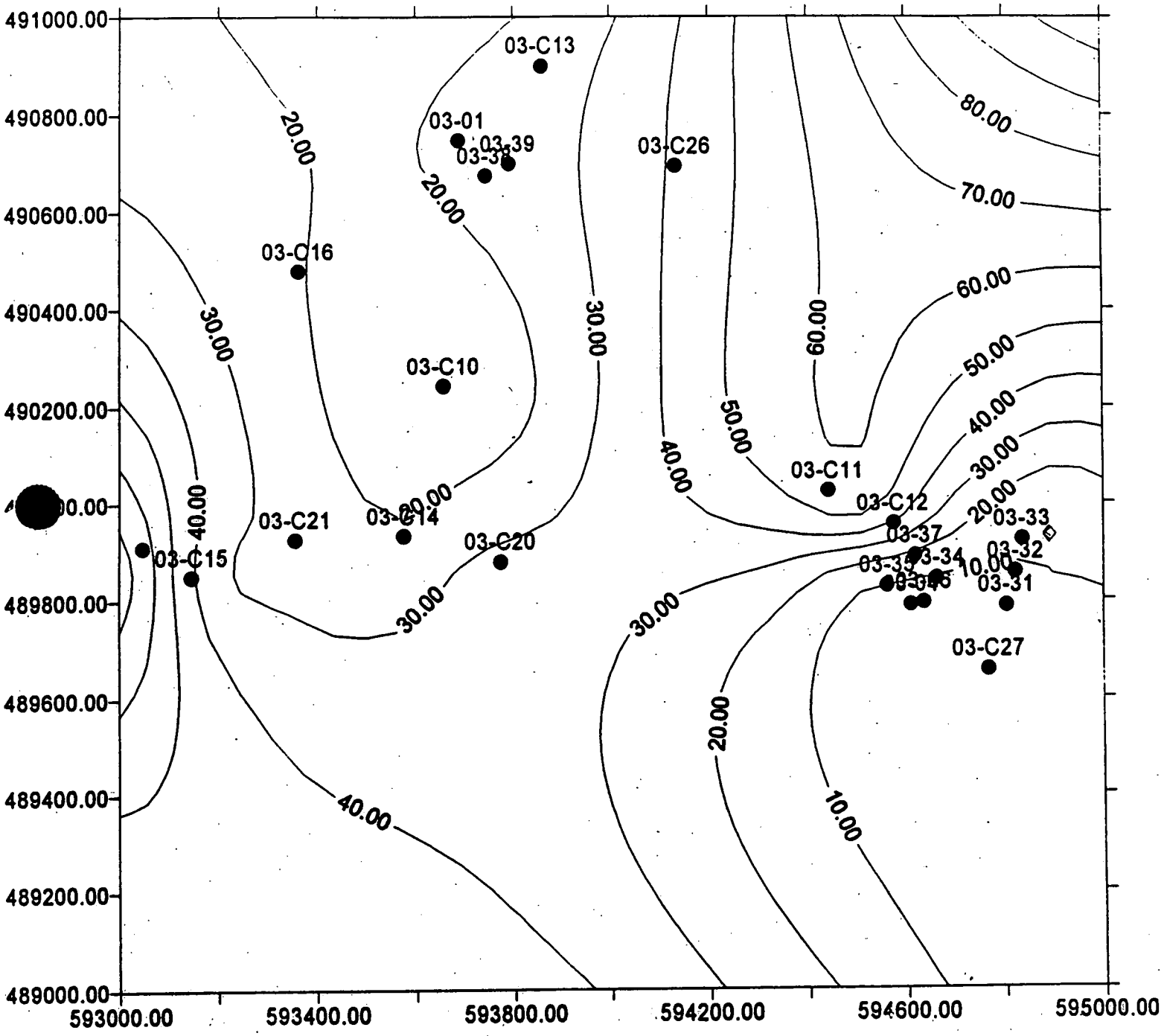


Figure 2.6. Isoconcentration map of Mg^{2+} in the vicinity of the ABG.

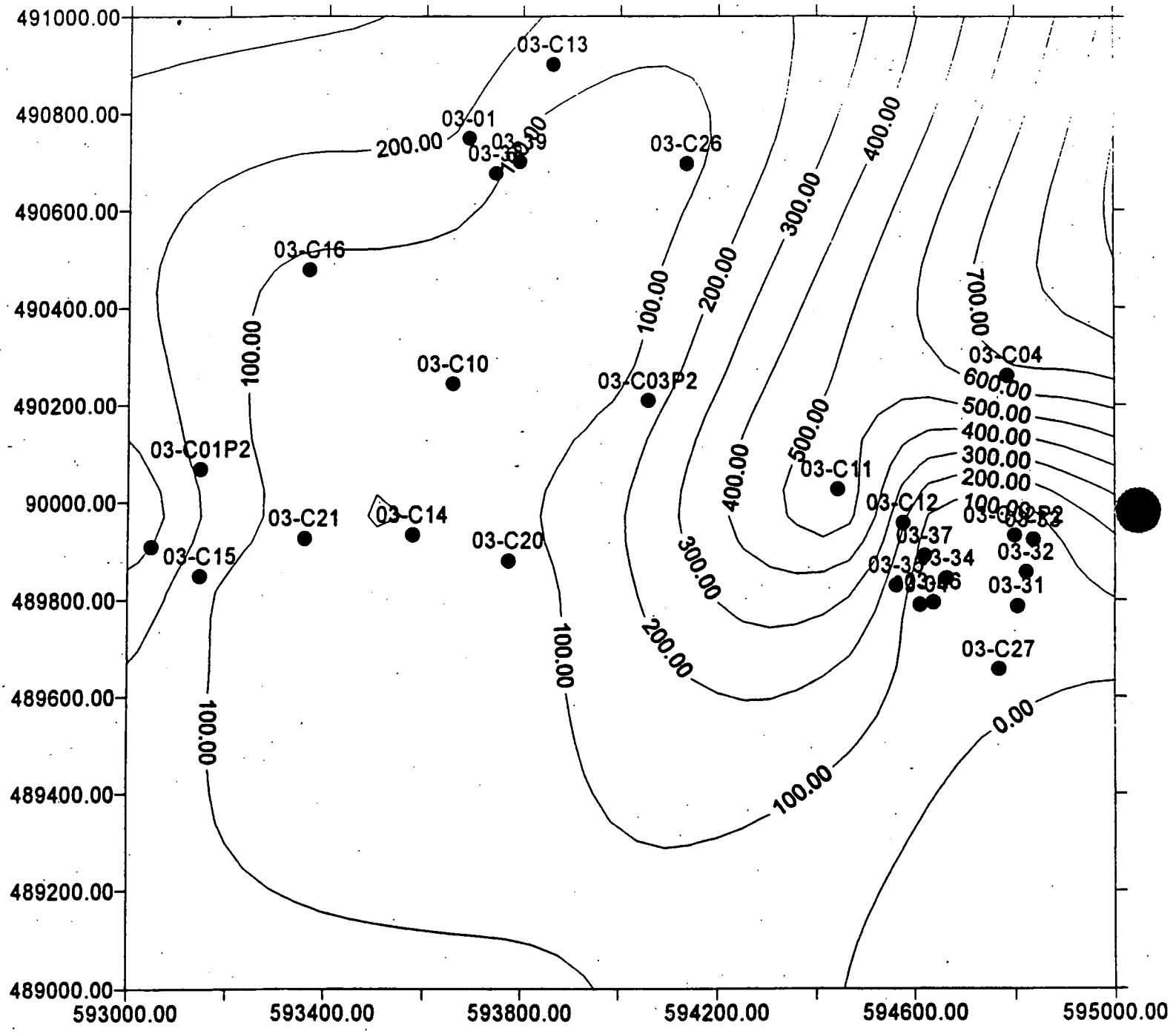


Figure 2.7. Isoconcentration map of SO_4^- in the vicinity of the ABG.

To test if groundwater constituents are being effected by the presence of the groundwater mound and trough, groundwater chemistries obtained from officials at NSWC for wells in the ABG were examined for trends in Mg^{2+} and SO_4^-. The basis for examining Mg^{2+} and SO_4^- is that many substances disposed of at the ABG are highly concentrated in these constituents (Tom Brent, NSWC Environmental Protection Office, pers. comm.). Figures 2.6 and Figure 2.7 show the resulting contoured maps of Mg^{2+} and SO_4^- concentrations, respectively. Both maps show that the concentrations of these constituents are relatively low immediately below the groundwater mound, a recharge zone (and of the burning practices near well 03-C10) and increase radially away from this area. The shape of the contours of concentration are dramatically impacted in the area of inferred karst (groundwater trough). It appears, and it is reasonable to assume, that the plumes of Mg^{2+} and SO_4^- are being drawn toward the groundwater trough. This implies that these constituents (and any other contaminants in the groundwater) are being discharged from springs in the Little Sulphur Creek valley and moving off-base.

It should also be noted that beneath the area of current burning, the concentrations of Mg^{2+} and SO_4^- are relatively low. This indicates that current disposal practices at the ABG are not contaminating the groundwater to the degree that they have in the past activities. Additionally, it is possible that all contamination existing in the groundwater system and currently entering the system are relicts of past operations at the ABG. It should be noted, that NO_3^- (another common constituent in the materials disposed of at the ABG) concentrations in the Beech show a similar pattern to Mg^{2+} and SO_4^- when they are contoured (DiGnazio, 1997).

Given the high concentrations of Mg^{2+} and SO_4^- that are in the Beech Creek aquifer due to disposal practices at the ABG, it is that not surprising that Piper (1944) diagrams of groundwater chemistry from this area show large variations (Figure 2.8). Groundwater are primarily of a

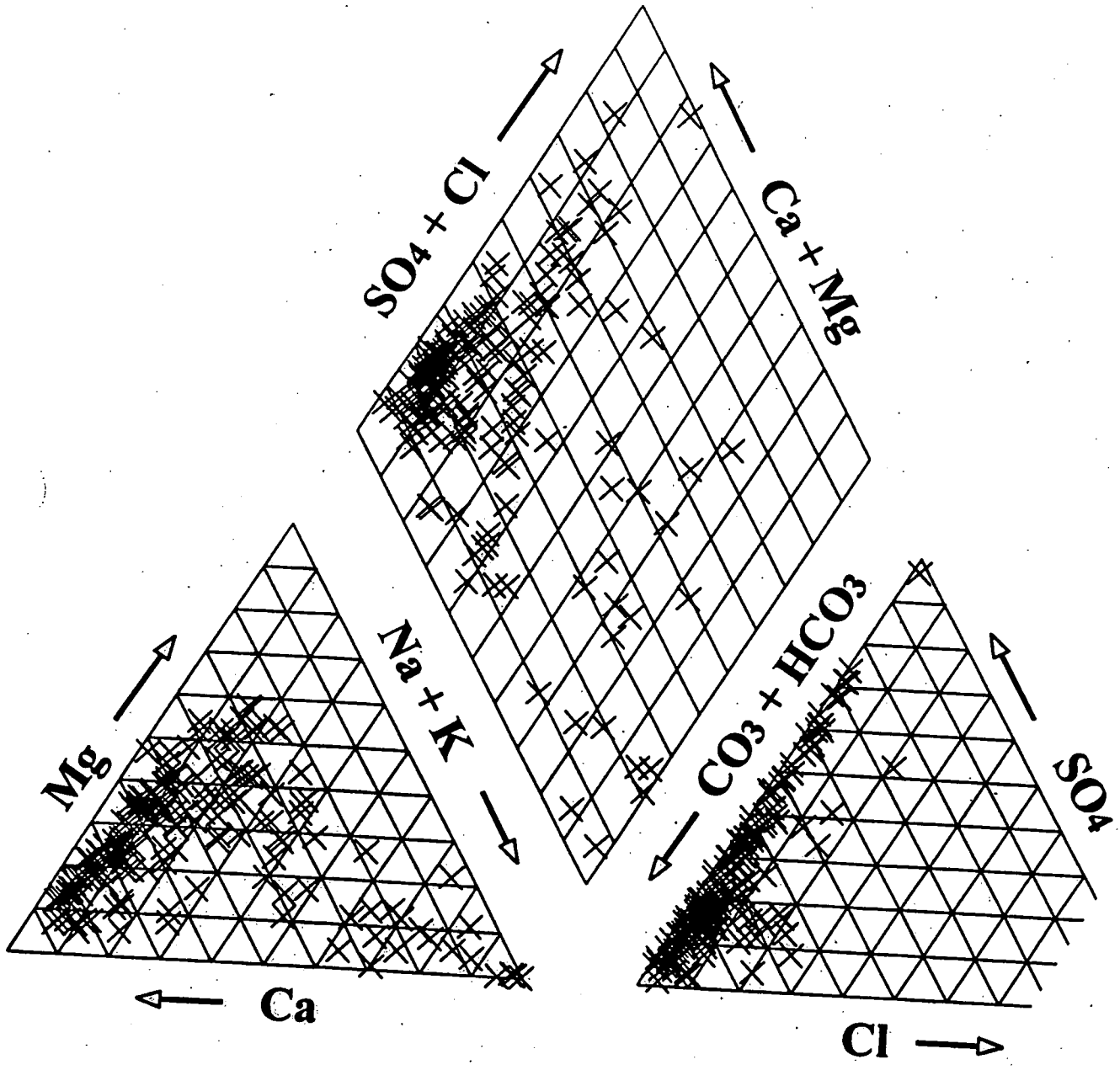


Figure 2.8. Piper diagram of all water chemistry analysis' taken from the Beech Creek aquifer.

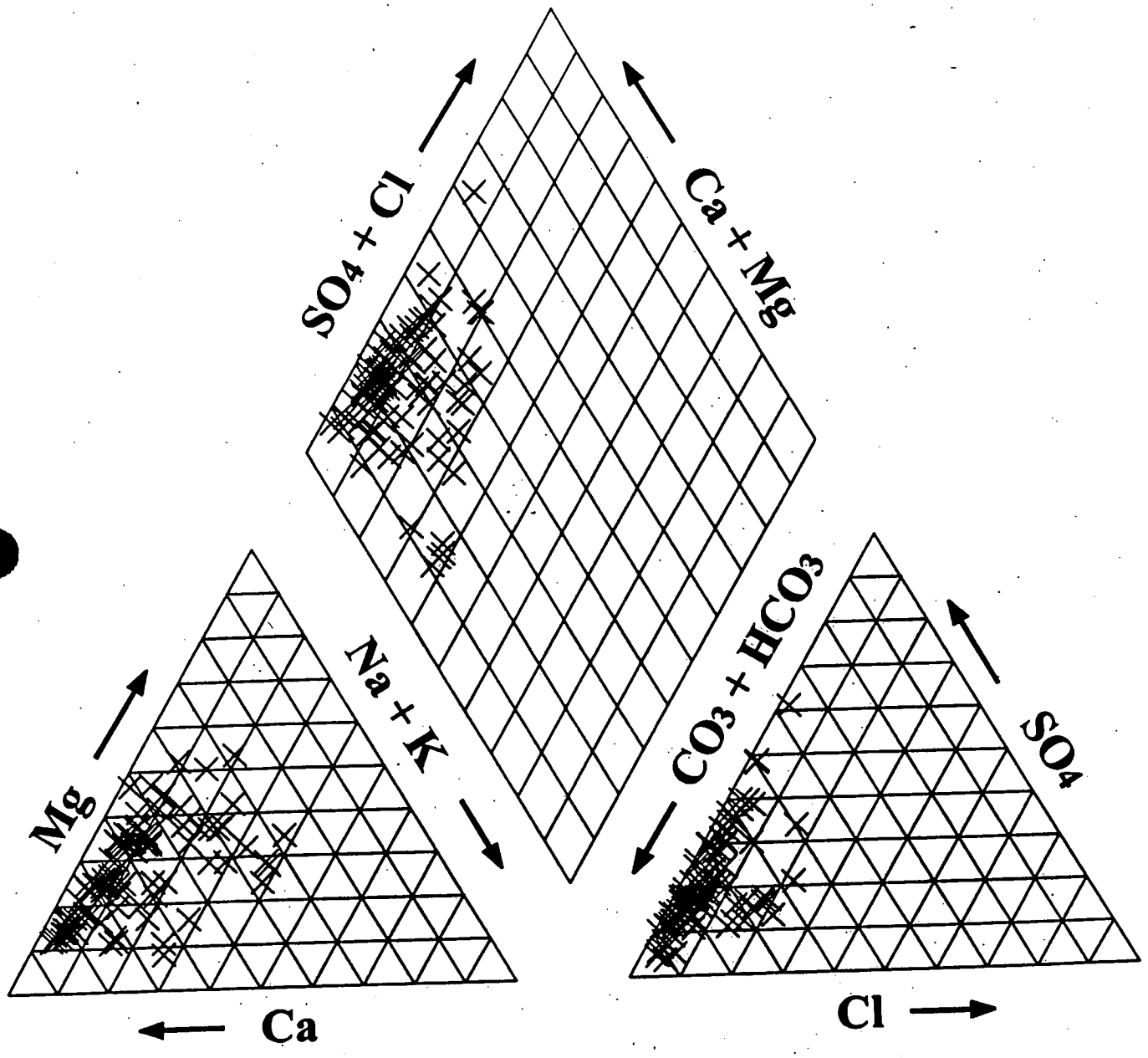


Figure 2.9. Piper diagram of water chemistry analysis' taken from "uncontaminated" wells in the Beech Creek aquifer.

Ca^{2+} + Mg^{2+} - HCO_3^- type. However a large number of groundwaters classify as: 1) Ca^{2+} + Mg^{2+}, Na^+ + K^+ - HCO_3^-; 2) Ca^{2+} + Mg^{2+}, Na^+ + K^+ - Cl^- + $SO_4^=$, HCO_3^-; 3) Na^+ + K^+, Ca^{2+} + Mg^{2+} - HCO_3^-; and 4) Na^+ + K^+ - HCO_3^-. Mg^{2+} and $SO_4^=$ from the disposal practices at the ABG cause these ions to occur in excess in groundwater samples. Na^+, K^+ and Cl^- also occur in excess in a few wells located close to access roads used by workers at the ABG. Given that these wells in close proximity to roads, the excess Na^+, K^+ and Cl^- are probably related to "salting" of roads in during winter months to keep them free of snow and ice.

A better representation of the "natural" geochemistry of the Beech Creek aquifer is shown in Figure 2.9. This figure was produced by removing all well chemistries that are within the $SO_4^=$ and Mg^{2+} plume (Figures2.6 and 2.7), as well as the chemistries of wells that are located right next to access roads in the ABG. The resulting plot shows that chemistries are Ca^{2+} + Mg^{2+} - HCO_3^- types, which is expected from a carbonate terraine.

Beaver Bend Aquifer

The Beaver Bend aquifer consists of the Beaver Bend limestone. It is a confined aquifer with 70 ft. of Elwren and Sample shales at its top. Hydraulic heads in this aquifer are 50 to 60 feet above the top of the aquifer and are 33 to 47 feet below the the heads in the overlying Beech Creek aquifer (Figure 2.10). Given the extreme differences in head and the presence of a very thick shale between these two aquifers, it is unlikely that any significant hydrologic connection exists between these two aquifers.

Groundwater in this aquifer is Na^+ - HCO_3^- in nature (Figure 2.11). The chemistry of groundwater from this aquifer is distinctly different and easily distinguished from the other

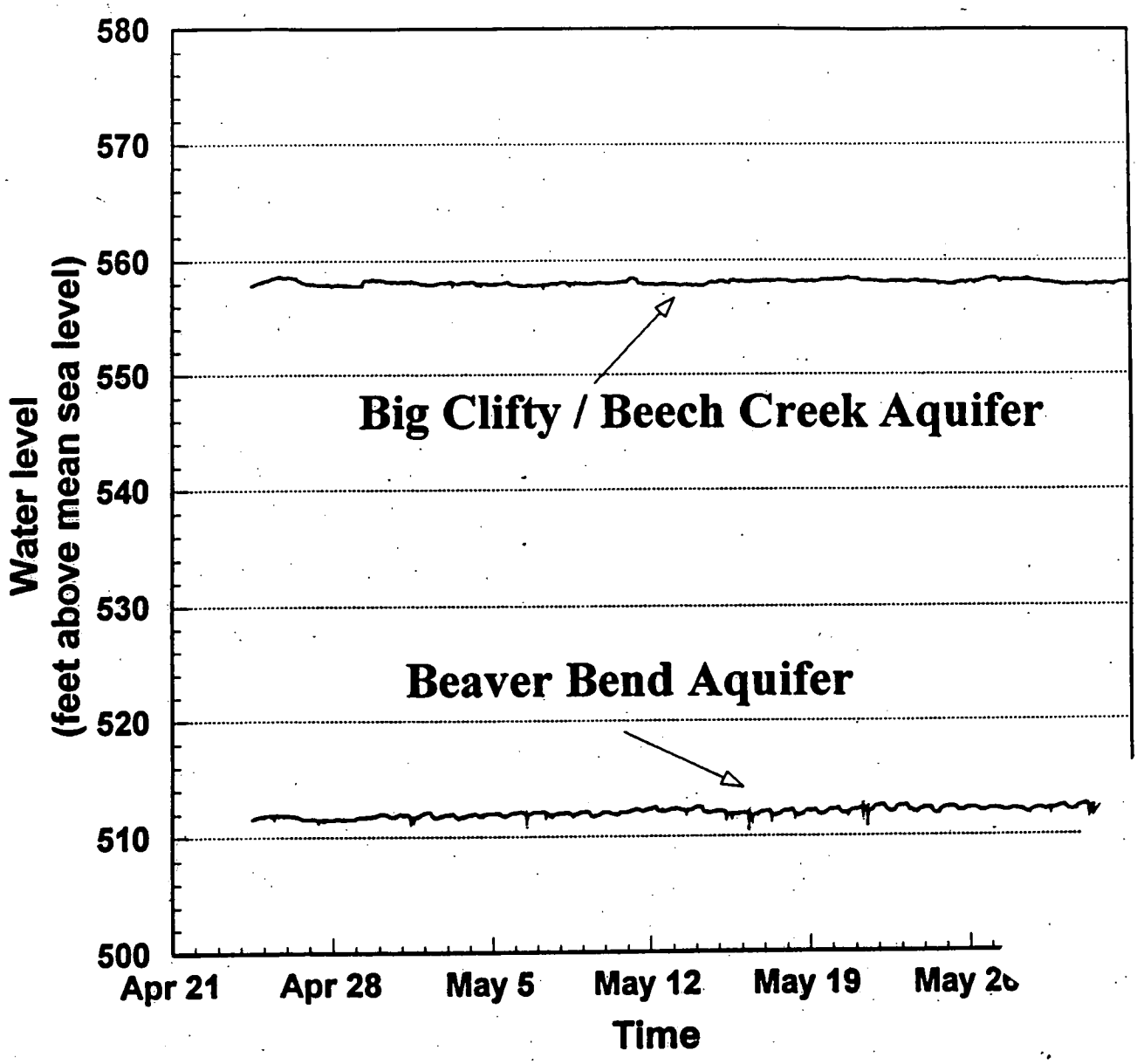


Figure 2.10. Graph comparing the hydraulic heads in the Beech Creek and Beaver Bend aquifers through time.

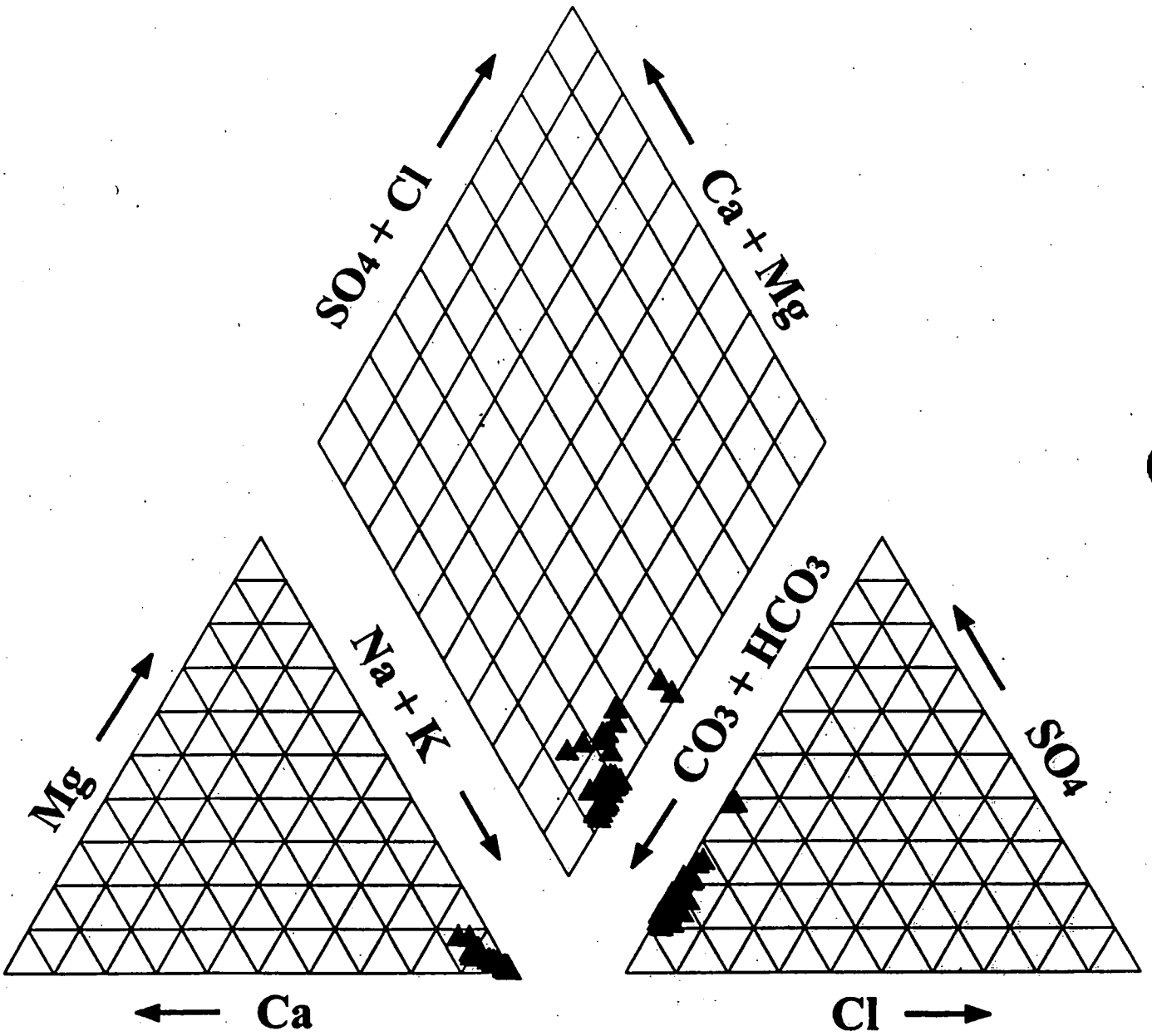


Figure 2.11. Piper diagram of water chemistry analysis' from wells in the Beaver Bend aquifer.

aquifers, thus supporting the hypothesis that there is very little connection between this aquifer and the overlying Beech Creek aquifer. The Na^+ - HCO_3^- nature of this water is most likely due to cation exchange processes in which Ca^{2+} and Mg^{2+} are taken out of the water and replaced with Na^+. The main requirement for this process is a large reservoir of exchangeable Na^+, which is most often provided by clay minerals. In this case the clay minerals are in the overlying shales of the Elwren and Sample Formations.

Since it appears that there is no significant hydrologic connection exists between the Beaver Bend and Beech Creek aquifers, this aquifer was not intensely studied for this project.

Study Area: Geochemical Modeling

Geochemical modeling is used to aid in determining whether wells in the ABG had undergone noticeable changes in groundwater chemistry through time, and if any changes were confined to specific geologic units. Two types of geochemical modeling are useful in answering these kinds of questions; 1) geochemical speciation modeling, and 2) geochemical reaction modeling.

These models allows constraints to be set on prevailing geochemical reactions that control groundwater chemistry. For this study, hydrochemical data were obtained from the Environmental Protection Group at the NSWC. This data consisted of 43,481 entries for the period of 1981 to 1992. For ease of management, this large database was reorganized into smaller datasets spanning a period beginning Jan. 1 and ending on Dec. 1 of each calendar year. A separate database containing the geologic units that each well in the ABG is screened in was also obtained from the NSWC.

To ensure quality control, all chemistry data were evaluated to ensure its integrity. Unfortunately, it was discovered that all analyses prior to 1987 are incomplete and could not be used for this study. For the period 1988 to 1992 only those wells that have complete analyses for major ions (pH, Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, HCO_3^-, SO_4^-, and Cl^-) are considered this study. Trace ions of fluoride and barium have also been included in the evaluation when they were available. Of the 43,481 entries in the database, only 872 water analysis' met these requirements. These analysis' are used to constructed the chemical models presented here.

Speciation Modeling

Speciation modeling allows determination of mineral saturation indices, which are indicators of the saturation state of a mineral with respect to a given water composition. The saturation index is defined as:

$$SI = \log\left(\frac{IAP}{Ksp}\right)$$

where SI is the saturation index, IAP is the ion-activity product as defined by a mass-action equation, and Ksp is the solubility product for the mineral. If the saturation index is less than zero, the mineral is undersaturated with respect to the solution and the mineral might dissolve. By similar reasoning, if the saturation index greater than zero, the mineral might precipitate but cannot dissolve. If the saturation index is close to zero, the mineral may not be reacting at all or may be reacting reversibly, in which case the mineral could be dissolving or precipitating. These conclusions are qualified by the accuracy of the chemical analysis and the aqueous model. Sources of uncertainty for this type of modeling are: 1) analytical data from the sample, 2) the

thermodynamic database used by the aqueous model, and 3) the solubility-product constants for the mineral.

WATEQ4F (Ball and Nordstrum, 1991) is a speciation program that was first developed by the United States Geological Survey (USGS) in the 1976 (Plummer, Jones, and Truesdale, 1976). The program uses a thermodynamic database that has been developed by the USGS. The database contains data for most geologically relevant aqueous components and mineral phases. The computer program implements an ion-association approach for developing the speciation model, which accounts for much of the non-ideality of aqueous solutions by forming complexes from the hydrated ions in solution (e.g. $Ca^{2+} + SO_4^{=} \Rightarrow CaSO_4^{\circ}$).

WATEQF was used in this study to make calculations of the saturation indices for minerals known to be (or may potentially be) geologically important in ABG area. These mineral phases are calcite (present in limestone), dolomite and aragonite (present in dolostone/aragonite and impure limestone), gypsum and anhydrite (present in gypsum/anhydrite and as a trace mineral in impure limestone and dolostone), and halite (present in halite and as a trace mineral in impure calcite, dolostone, and gypsum). The results are presented below.

Mansfield Formation and Golcanda-Haney Aquifer

Wells screened in the Mansfield / Golcanda for which sufficient chemistry data are available to make interpretations of major ion chemistry are: 03-28, 03-C22, 03-C8P3, 03-C23, 03-C21P2, 03-C1P3, 03-C19P3, 03-C18, and 03-C15P3.

As pointed out before, groundwater from these wells are Ca^{2+} - HCO_3^- in nature (Figure 2x). Major ion chemistry from these wells show some variability through time as indicated by the saturation indices of aragonite, calcite, and dolomite (see Appendix 5). Waters from these wells range from being undersaturated to oversaturated with respect to aragonite, calcite, and dolomite. Saturation indices for gypsum and anhydrite are consistently around -2. The saturation indice for halite ranges from -9 to -8.

The most likely reason for the observed variability in saturation states for these waters is due to aerial recharge to this aquifer. During rain events, fresh undersaturated water (with respect to aragonite, calcite, dolomite, gypsum, anhydrite, and halite) enters and recharges the system and becomes groundwater. As this water slowly moves slowly through the aquifer, it becomes more saturated with respect to available mineral phases (calcite, aragonite, and possibly dolomite). Given enough time, these waters may become oversaturated with respect to these phases. The relatively constant saturation indices for gypsum, anhydrite, and halite are due to the lack (or very small amount) of these mineral phases in this unit.

Beech Creek Aquifer

There are two categories of wells that are screened in portions of the Beech Creek aquifer. The first are wells that are screen either in the Big Clifty formation or across the Big Clifty and into the Beech Creek limestone. For this category of wells, information is either too incomplete to decide the formation that the wells are screen into, or the contact between the formations was not clearly located. The second category of wells are those that are clearly screened in the Beech Creek limestone.

Wells screened in the Big Clifty or the Big Clifty / Beech Creek, where sufficient chemistry data are available to make interpretations of major ion chemistry are: 03-09, 03-33, 03-01, 03-31, 03-34, 03-37, 03-38, 03-39, and 03-32. A separate Piper diagram has been constructed for these wells (Figure 2x), which shows that all groundwaters are Ca^{2+} - HCO_3^- in nature (see Appendix 6). Major ion chemistry from these most of these wells show considerable variability through time as indicated by the saturation indices of aragonite, calcite, and dolomite ranging from -1 to 1 (see Appendix 6). Saturation indices for gypsum and anhydrite are consistently around -1 to -2. The saturation indice for halite ranges from -9 to -8.

Wells that are clearly screened in the Beech Creek where sufficient chemistry data are available to make interpretations of major ion chemistry are: 03-04, 03-06, 03-35, 03-C10, 03-C12, 03-C13, 03-C11, 03-C14, 03-C15, 03-C16, 03-C17, 03-C19, 03-C1P2, 03-C20, 03-C21, 03-C24, 03-C25, 03-C26, 03-C27, 03-C28, 03-C2P2, 03-C30, 03-C31, 03-C32, 03-C3P2, 03-C4, 03-C5, 03-C6, 03-C7, 03-C8P2, 03-C9P2, and 03-CB10.

The variability in saturation states for these waters are either the result of aerial recharge (as was the case with the Golconda-Haney aquifer) in areas where these units are exposed or, in areas where these units are not exposed, due to variable recharge from the Golconda-Haney aquifer. Again, gypsum (anhydrite) and halite saturation indices remain relatively constant due to the lack (or very small amount) of these mineral phases in this unit.

Waters from these wells are predominately Ca^{2+} - HCO_3^- in nature although there are smaller populations of data which are Mg^{2+} - $SO_4^=$ and Na^+ - HCO_3^- (see Appendix 7). Examination of the speciation model output for these wells show two populations of data; 1) those

wells that show considerable variability through time in the saturation indices of aragonite, calcite, dolomite, and halite, and 2) those wells that remain relatively consistent through time in the saturation indices of aragonite, calcite, dolomite, and halite. The wells which show variability in saturation indices are: 03-04, 03-35, 03-C19, 03-C24, 03-C25, 03-C27, 03-29, 03-C2P2, 03-C30, 03-C31, 03-C32, 03-C3P2, 03-C4, 03-C9P2, and 03-CB10. The wells which show relatively little variability in saturation indices are: 03-06, 03-C10, 03-C12, 03-C11, 03-C13, 03-C14, 03-C15, 03-C16, 03-C17, 03-C1P2, 03-C20, 03-C21, 03-C25, 03-C26, 03-C28, 03-C5, 03-C6, 03-C7, 03-C8P2, 03-C9P2, and 03-CB10.

Krothe and Baedke (1992) hypothesized that the wells that showed little variability in saturation indices of aragonite, calcite, dolomite, and halite may have belonged to a system that allows very little fluctuation in water entering or leaving the system. This was interpreted as the diffuse-system. Conversely, the wells that showed considerable fluctuation in saturation indices of aragonite, calcite, dolomite, and halite were being effected by a different system. This system was thought to be the conduit-system. While this interpretation may be true, it now seems that the conduit system is not as pervasive beneath the ABG as previously thought. Additionally, it now seems likely that an artificially introduced plumes of Mg^{2+}, SO_4^-, and Na^+ exists beneath the ABG. Additionally, the plumes Mg^{2+} and SO_4^- appear to have migrated away for the source area. If this has really happened, then the variation in saturation indices for dolomite and gypsum should show the changes though time as the plume has migrated to and from wells in the ABG. Indeed certain wells, for instance 03-04, 03-29, 03-35, 03-10, and 03-26, clearly show a pattern that could be related to movement of the contaminant plume.

<u>Beaver Bend Aquifer</u>

Wells screened in the Beaver Bend with sufficient chemistry data to make interpretations of major ion chemistry are: 03-C2, 03-C3, 03-C8A, 03-C9, and 03-C1. Graphs for results of the speciation model are presented in Appendix 2.x.

As pointed out earlier, all groundwater from these wells are Na^+ - HCO_3^- in nature (see Figure 2x) as a result of cation exchange. Major ion chemistry from these wells show very little variability through time in as indicated by the saturation indices of aragonite, calcite, dolomite, gypsum, anhydrite, and halite. Specifically, the waters are saturated with respect to calcite and aragonite (SI $\approx$0); undersaturated with respect to gypsum and anhydrite (SI $\approx$-3); saturated to oversaturated with respect to dolomite (SI $\approx$0.5 to 1.5), and very undersaturated with respect to halite (SI $\approx$-7 to -8).

Geochemical Reaction Modeling

Geochemical reaction models are tools that aid in the determine prevailing geochemical reactions and allows quantification of the extent to which these reactions occur. This type of modeling provides valuable insight into the evaluation of trends in chemical composition of groundwater samples. There are two types of reaction modeling: 1) inverse modeling, which uses observed groundwater compositions to deduce geochemical reactions; and 2) forward modeling, which uses hypothesized geochemical reactions to predict groundwater compositions (Parkhurst and Plummer, 1993). In the situation where there is an abundance of geochemical data, inverse modeling is the most useful approach because the results always reproduce the chemistry of the available samples and the results are consistent with known thermodynamic constraints and mineralogic observations. In situations where the system or chemical constituents are unavailable, the forward modeling approach is often applied. The forward approach is also capable of

predicting the effects of advection, dispersion, and spatial and temporal distributions of minerals and groundwater composition. Due to the abundance of data available to this study, the inverse modeling approach will be used.

Mass-balance modeling is a type of inverse model that attempts to determine the nature and extent of geochemical reactions that are occurring in a groundwater system by identifying the minerals that are reacting and determining the amounts of these minerals that dissolve or precipitate. The conceptual model used here is that two waters, for which chemical data exist, are on a single flow line, and, therefore the downgradient (referred to as final) water composition is derived from the upgradient (referred to as initial) water composition by the occurrence of geochemical reactions (Parkhurst and Plummer, 1993).

The USGS program PHRQPITZ (Plummer et al., 1986) was used to make predictions of possible geochemical reactions taking place along two hypothetical flow paths. These two hypothetical flow path scenarios are: 1) Groundwater in the Beech Creek limestone flows from the ABG southwestward along the drainage of the Little Sulfur Creek, and flows off base, and 2) Groundwater originating in the Mansfield formation flow vertically (across formations) into the Golconda limestone, then into the Big Clifty, then into the Beech Creek limestone.

Results from the first scenario indicate that the movement of groundwater confined to the Beech Creek aquifer, along a path from 03-07 to 03-C27 to ????, can replicate the hydrochemical conditions along the hypothetical flow path. However, in order to produce results that are consistent with observed concentrations of Mg^{2+}, significant reactions with dolomite need to occur. However, according to researchers at the Indiana Geological Survey the Beech Creek limestone

Constituent	Weight Percent
$CaCO_3$	95.2%
$MgCO_3$	1.27%
SiO_2	1.50%
Al_2O_3	0.40%
Fe_3CO_3	1.34%
TiO_2	<0.01%
MnO	0.06%
S	0.05%
P_2O_5	0.03%

Table 2.2 - Average weight percent composition taken from 7 samples of Beech Creek limestone. Samples were collected from Greene, Lawrence, Orange, and Crawford counties in Indiana (source Peg Ennis, IGS, personal communication).

contains little or no appreciable dolomite when observed in outcrop (John Rupp, IGS, personal communication). Additionally, whole rock analysis' of the Beech Creek limestone indicate that Mg^{2+} occurs in only trace amounts (<3%). Table 2.x shows the average of seven whole rock analysis' from the Beech Creek limestone taken from Greene, Lawrence, Orange, and Crawford counties in Indiana (Peg Ennis, IGS, personal communication). Therefore, the results of this reaction path model cannot produce results that are consistent with known geologic conditions.

The second scenario, cross formational flow, from Mansfield to Golconda to Big Clifty to Beech Creek (wells 03-28 to 03-C22 to 03-04 to 03-C10 respectively) is also capable of replicating known groundwater chemistries without violating known geologic conditions. In this scenario, groundwater in the Mansfield move vertically into the Golconda and dissolves dolomite (in the dolostone of the Golconda), gypsum and halite (possible as impurities in limestone or

dolostone), while precipitating calcite (in the limestone of the Golconda). From the Golconda, water moves vertically to the Beech Creek aquifer where it needs to dissolve a sodium bearing mineral to account for increased Na+ in the system (I've chosen natron $NaHCO_3$), as well as dolostone to account for Mg2+. By allowing these reactions to occur, precipitation of calcite, gypsum, and halite also need to occur in order to mass balance the system.

In addition to the second scenario violating the known geologic condition of very little dolomite occurring in the Beech Creek aquifer, it requires additional reactions between mineral phases not known to exist in the area (i.e. natron, halite, and gypsum). This scenario is not likely to happen.

Conclusions

Even under simplistic geologic and hydrologic conditions, past and present disposal operations at the ABG would pose a significant threat to the groundwater systems in the Little Sulphur Creek drainage basin. However, the scenario at the ABG is much more complicated than a simple system. This system posses multiple aquifers that may become contaminated as wells as multiple pathways of groundwater, and therefore contaminant, movement.

There are 3 aquifers in the vicinity of the ABG. The uppermost is the Golconda-Haney aquifer. Two strong lines of evidence make it appear that the groundwater in this aquifer is not in danger of contamination by the activities at the ABG. Firstly, this aquifer is stratigraphically above the area in the ABG where disposed of munitions are taking place. And secondly, the groundwater chemistry in this aquifer can be explain by natural reactions with geologic materials in the aquifer and does not appear to abnormal.

The Beech Creek aquifer is beneath the Golconda-Haney. This aquifer is karstic in nature and therefore has the potential to become contaminated (and is very likely contaminated at this time). The karstic nature of this aquifer appears to dramatically impact the flow of groundwater, and therefore contaminants, in the ABG. The lines of evidence that support these statements are:

1) Disposal practices at the ABG take place on top of the Beech Creek aquifer and therefore any vertical movement of contaminants from the site would enter it.

2) Surface drainage from the area of burning enters Little Sulphur Creek which is in contact with the Beech Creek aquifer, therefore any contaminants carried away by surface drainage would enter the aquifer.

3) Water table maps constructed from data from wells in the ABG show a single groundwater trough in the ABG. This trough, in the vicinity of well 03-C2P2, is interpreted as indicating the presence of a karst conduit at this location. The water table map also shows that a groundwater mound exists in the vicinity of well 03-10.

4) Isoconcentration maps of SO_4^- and Mg^{2+} (common components of materials disposed of at the ABG) show distinctive plumes of these aqueous species in the Beech Creek aquifer. The concentrations of these species cannot be explained by geochemical modeling of the natural system and are therefore believed to related to the ABG operations.

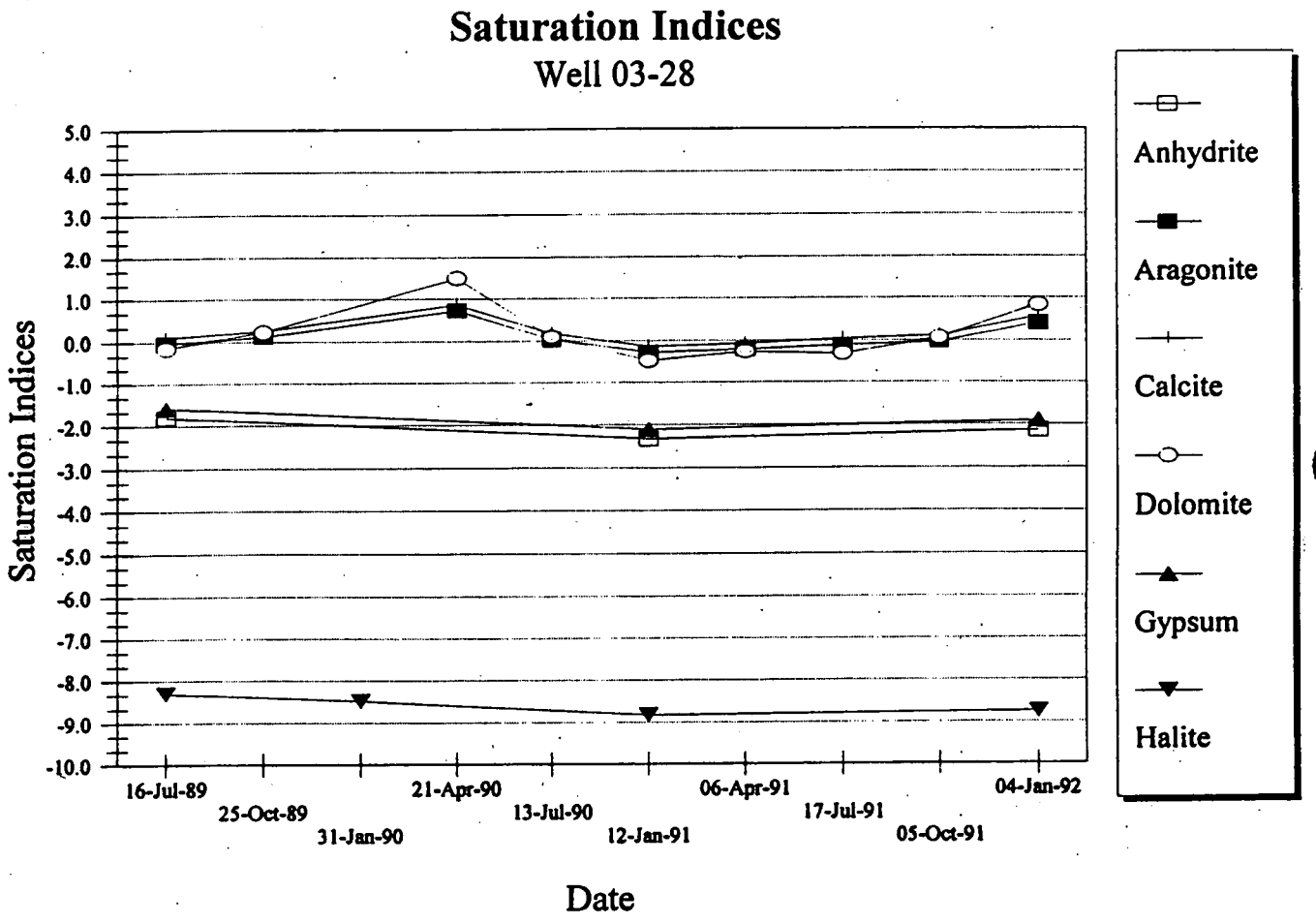
5) The isoconcentration maps indicate that the plumes of SO_4^- and Mg^{2+} are moving toward the karst conduit near well 03-C2P2. The maps also shows that directly beneath and adjacent to the area current being used to burn munitions at the ABG, there is relatively low concentrations of SO_4^- and Mg^{2+}. This is interpreted as indicating that current precautions used at the ABG are not impacting the groundwater quality to the level that they once did. It is possible, in fact, that the plume of SO_4^- and Mg^{2+} could be entirely related to past activities at the ABG.

Since this aquifer is contaminated, it is important to understand the movement of groundwater through it. Previous studies have shown that karst features around well 03-C2P2 are hydrologically connected to downgradient springs in the Little Sulphur Creek. These studies were unable, though, to determine how much of the material entering the conduit of system below well 03-C2P2 emerges at these springs. A quantitative dye trace has been conducted as part of this project in order to address this question and the results are presented in Chapter 3.

The Beaver Bend aquifer is below the Beech Creek aquifer. It is hydrologically isolated from, and so it is unlikely to be contaminated by groundwaters from the Golconda-Haney and Beech Creek aquifers. Additionally, the chemical signature of waters from this aquifer can be explained by natural geochemical processes.

Appendix 2.1

Speciation Model Results for the Wells Screen in the Golconda-Haney Aquifer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12-Jan-91
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Aragonite
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Dolomite
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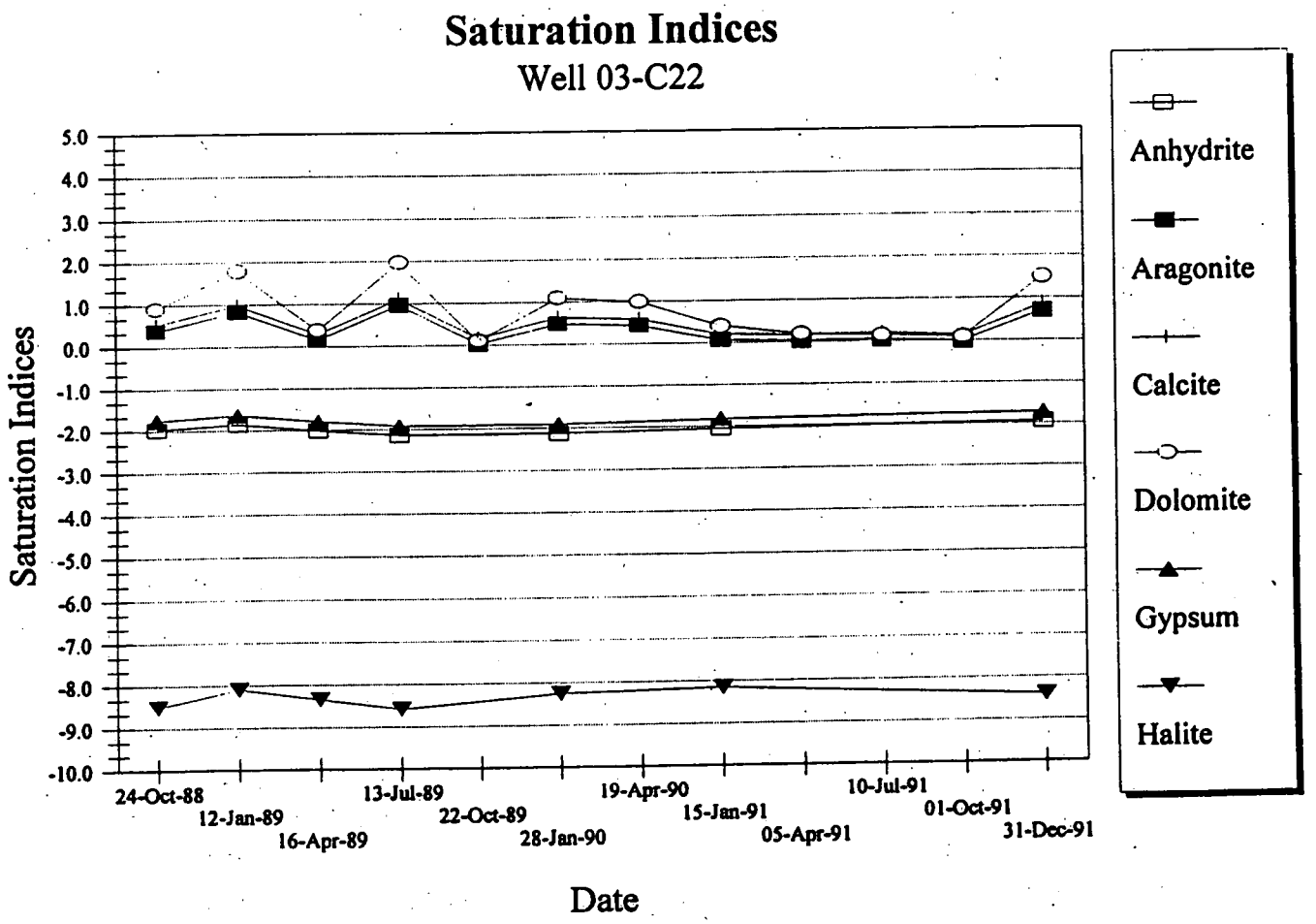
Halite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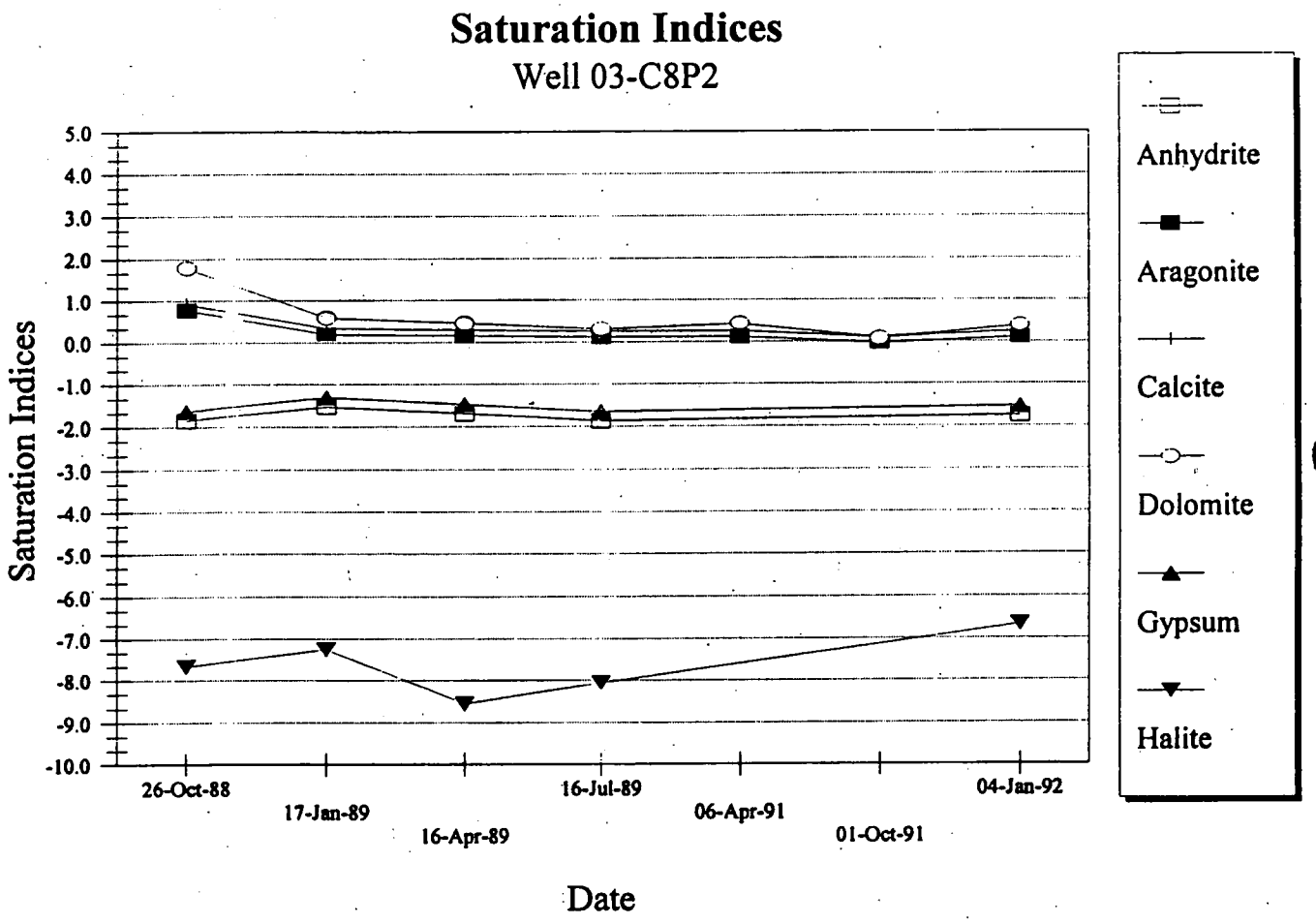
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16-Apr-89
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Date
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Dolomite
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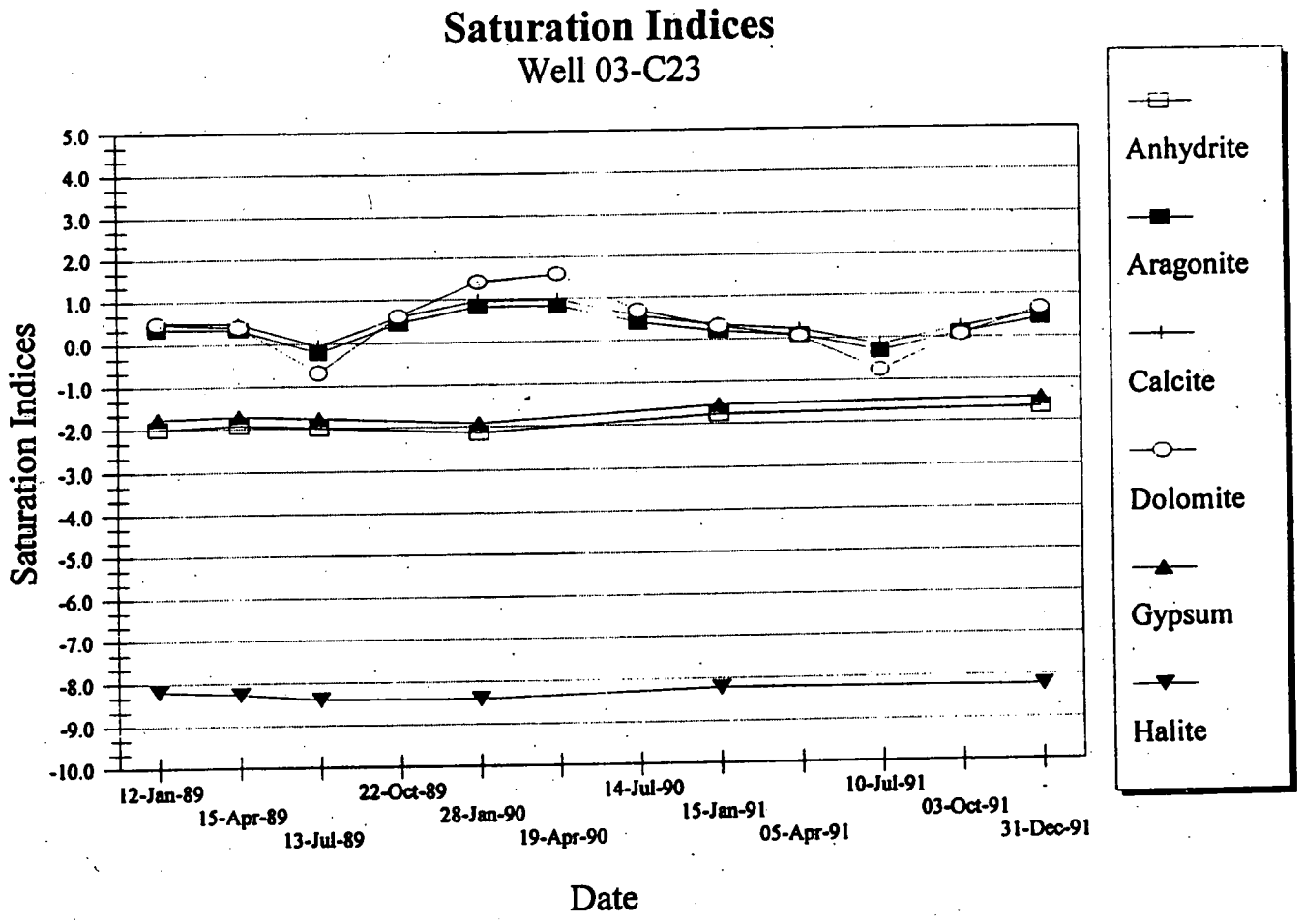
Halite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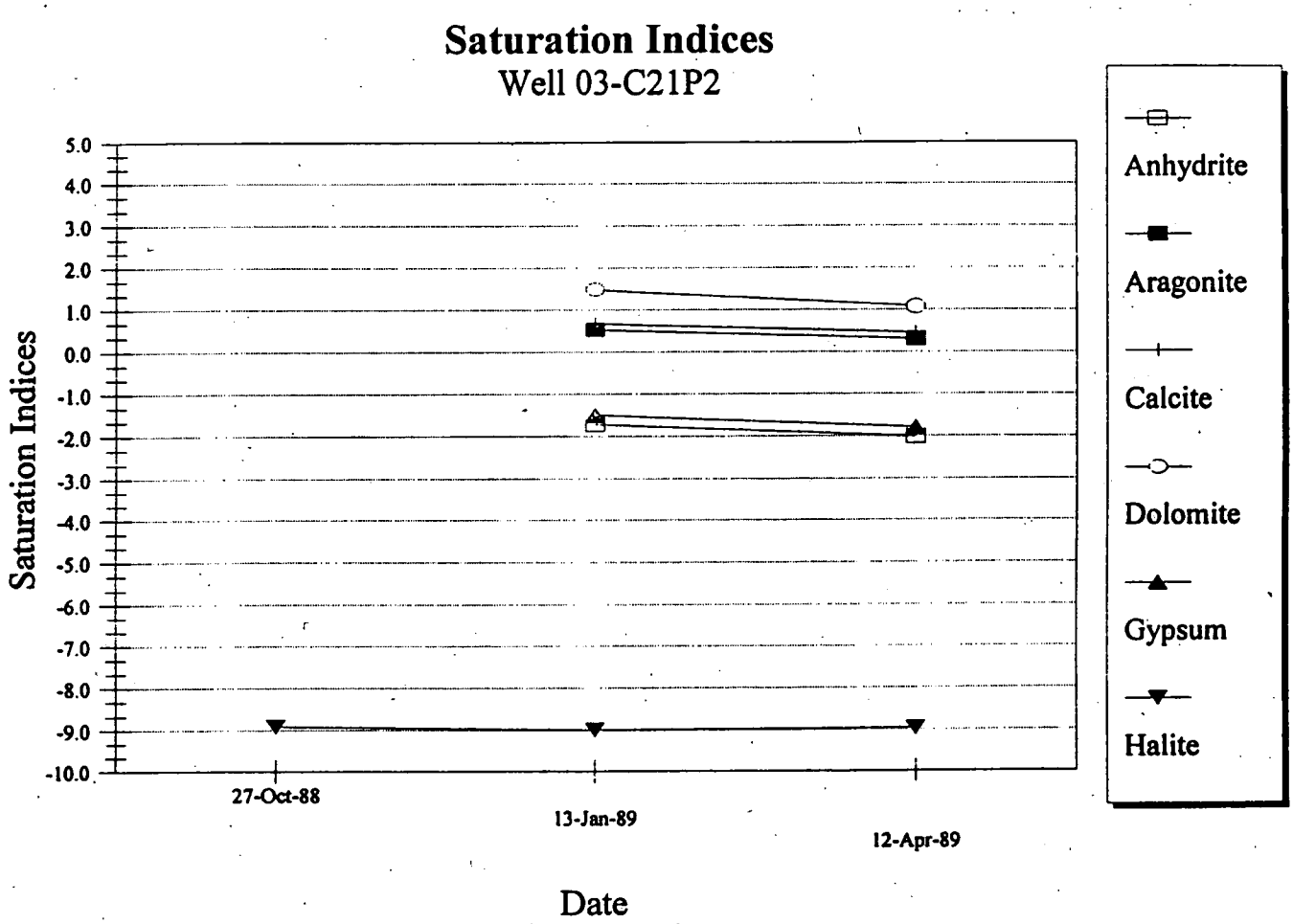
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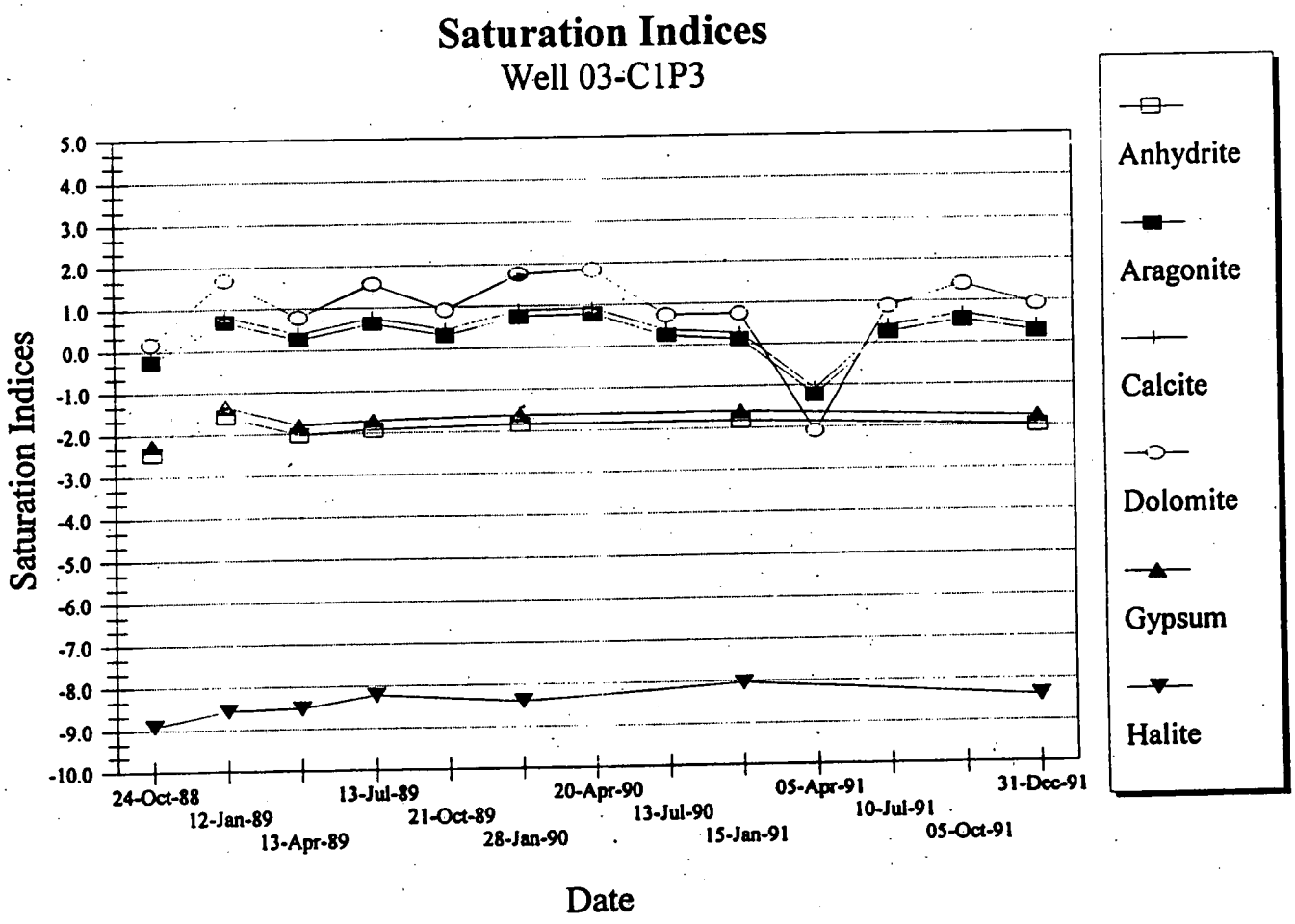
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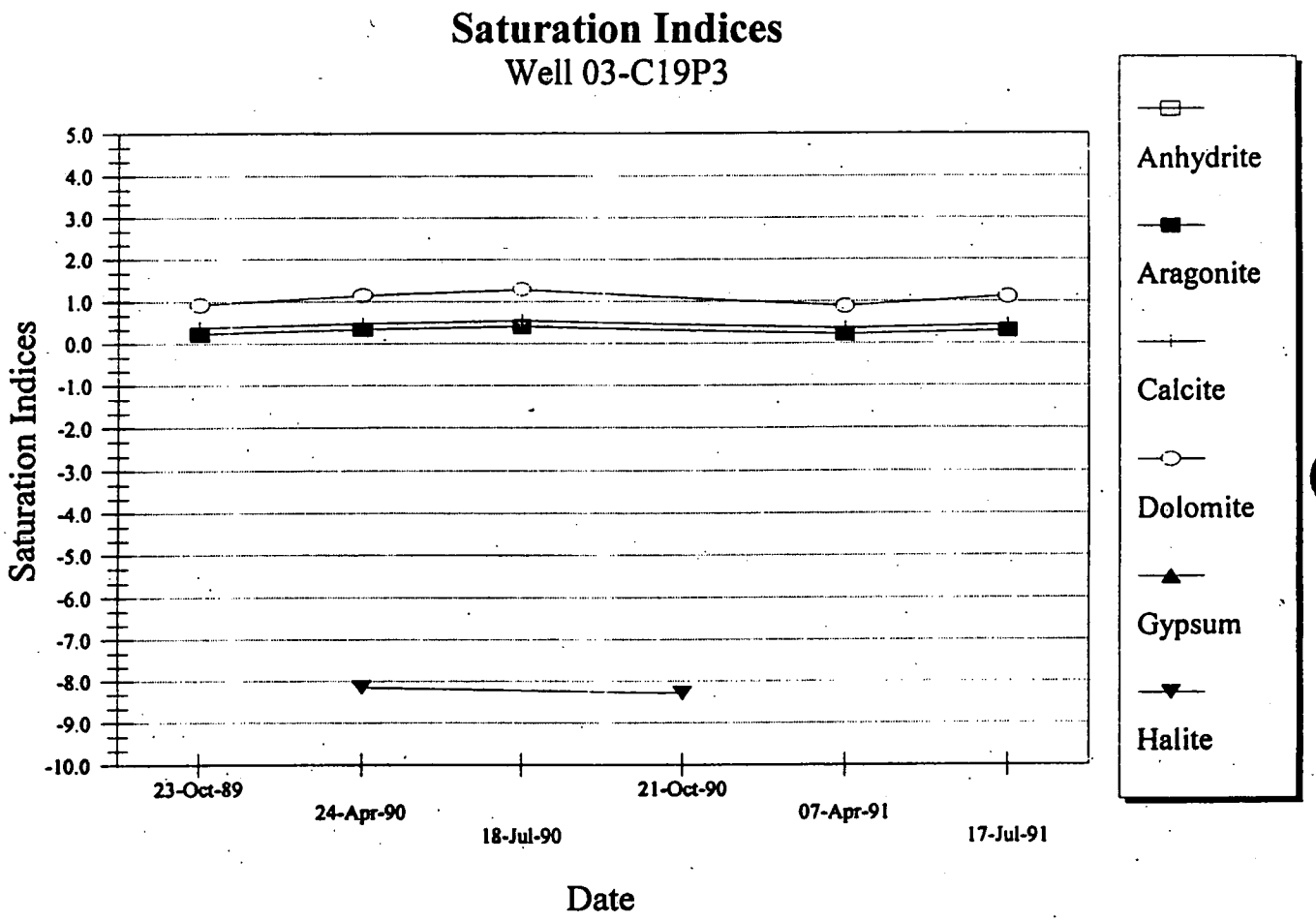
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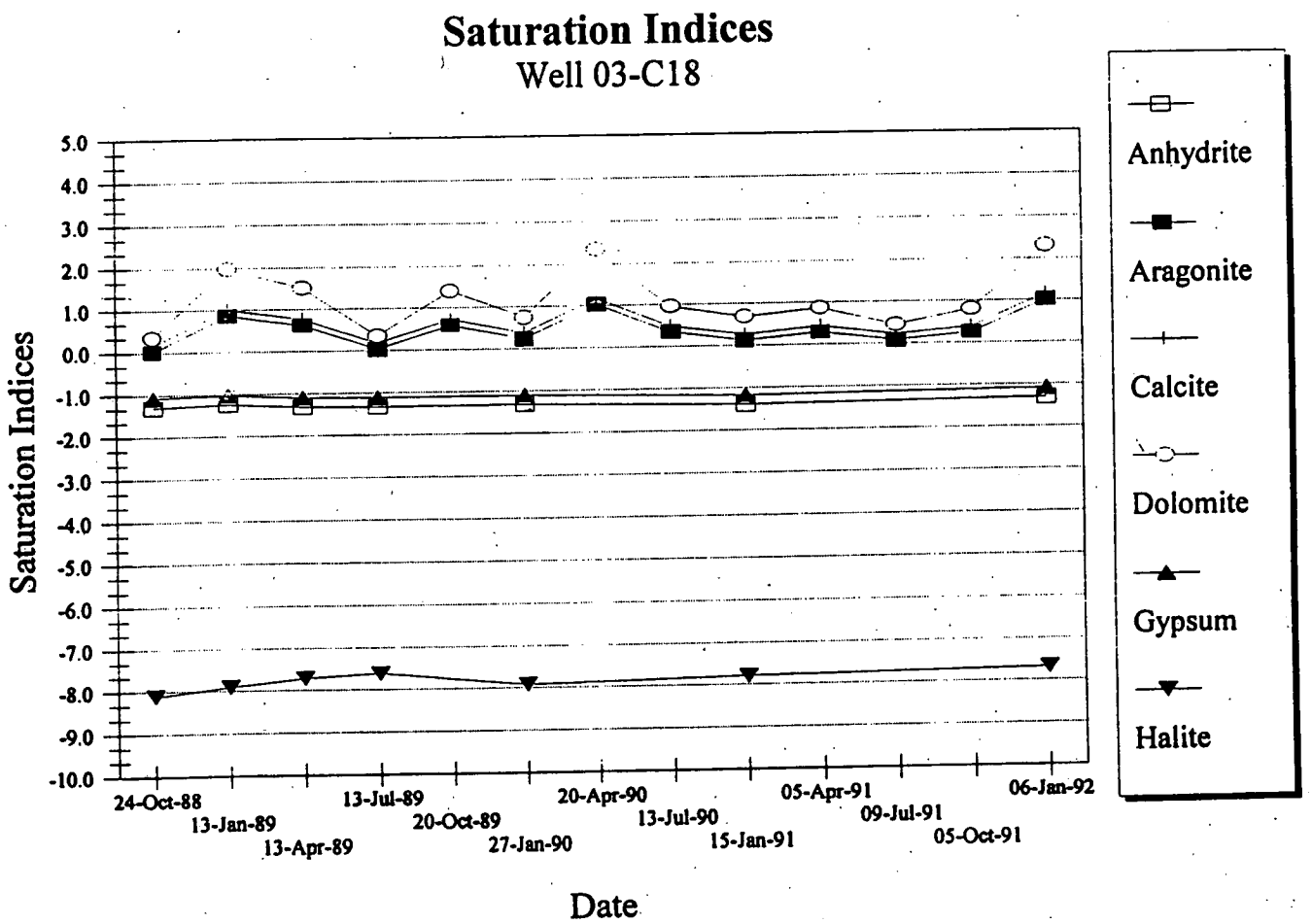
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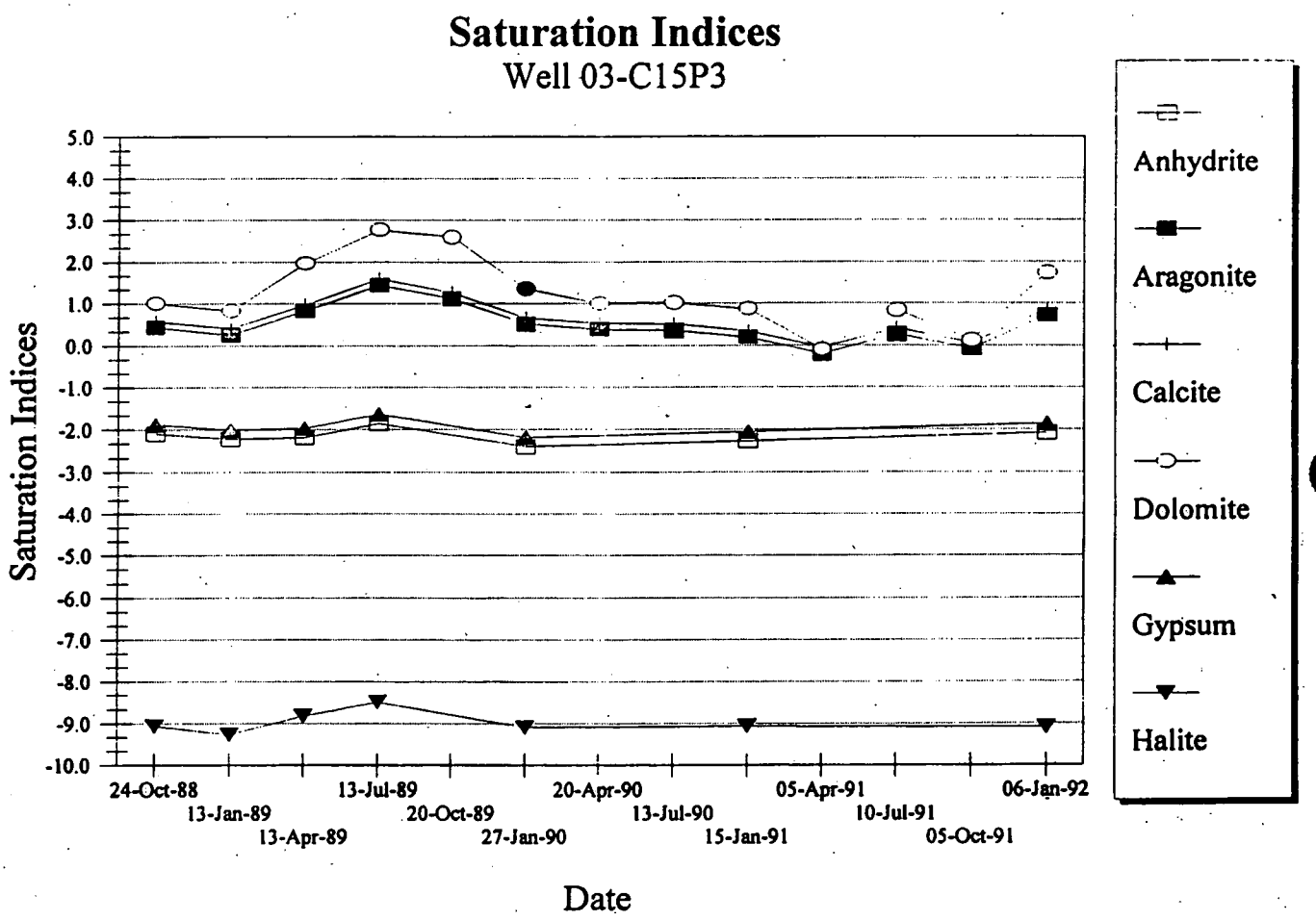
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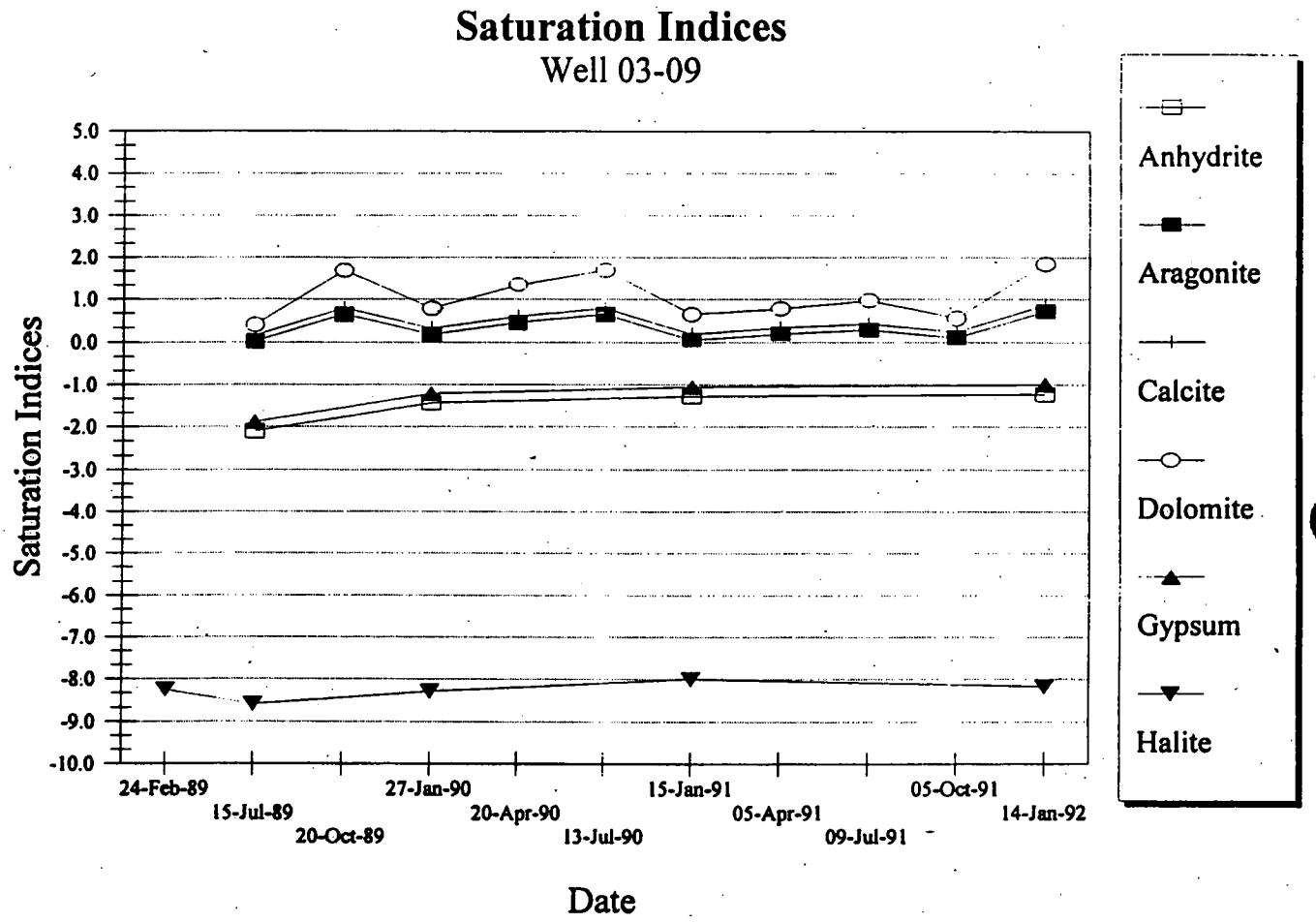
06-Jan-92
Date
Anhydrite
Aragonite
Calcite
Dolomite
Gypsum
Halite

Appendix 2.2

Speciation Model Results for Wells Screened in Big Clifty Formation or in the Big Clifty and Beech Creek Formations of the Beech Creek Aquifer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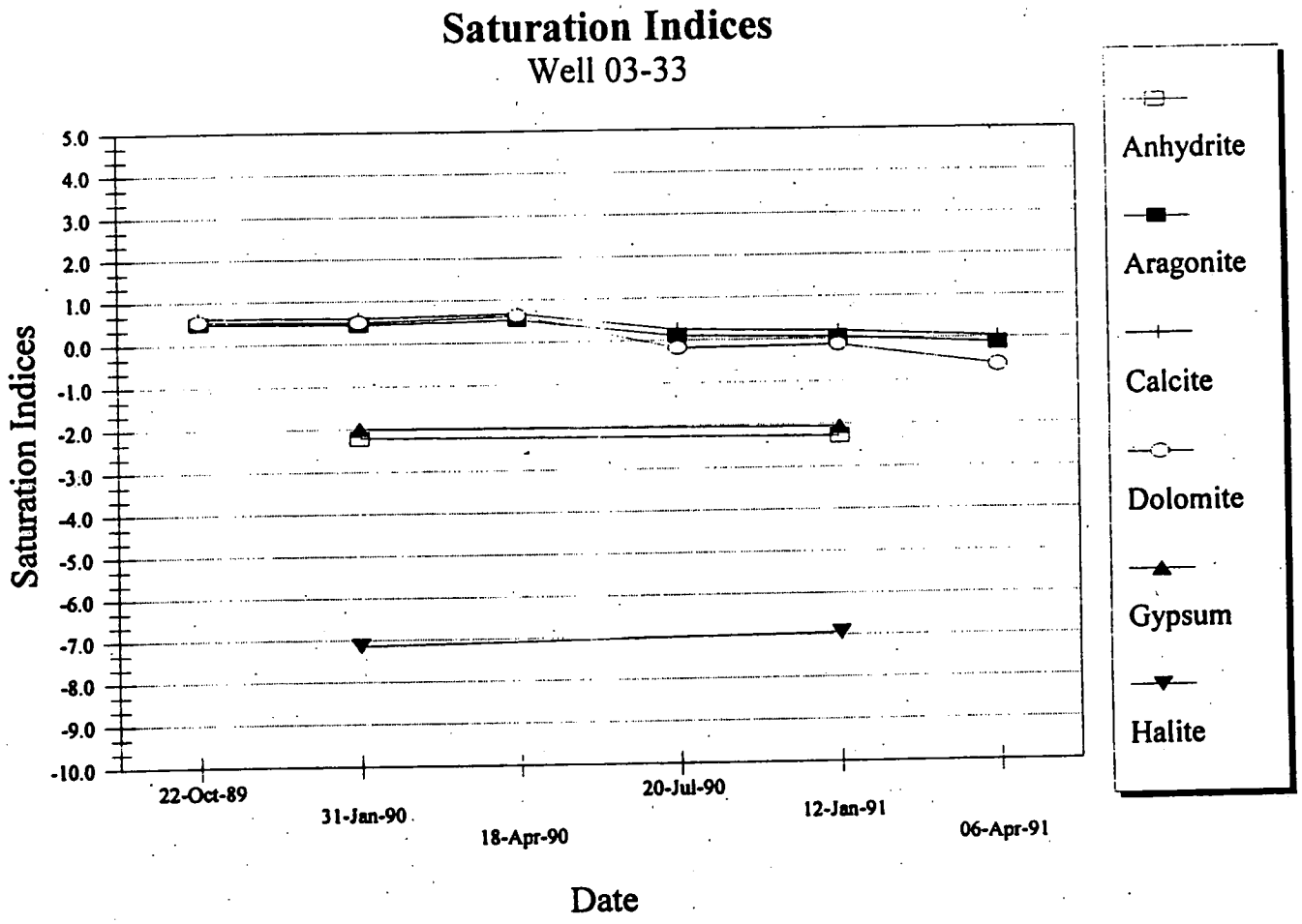
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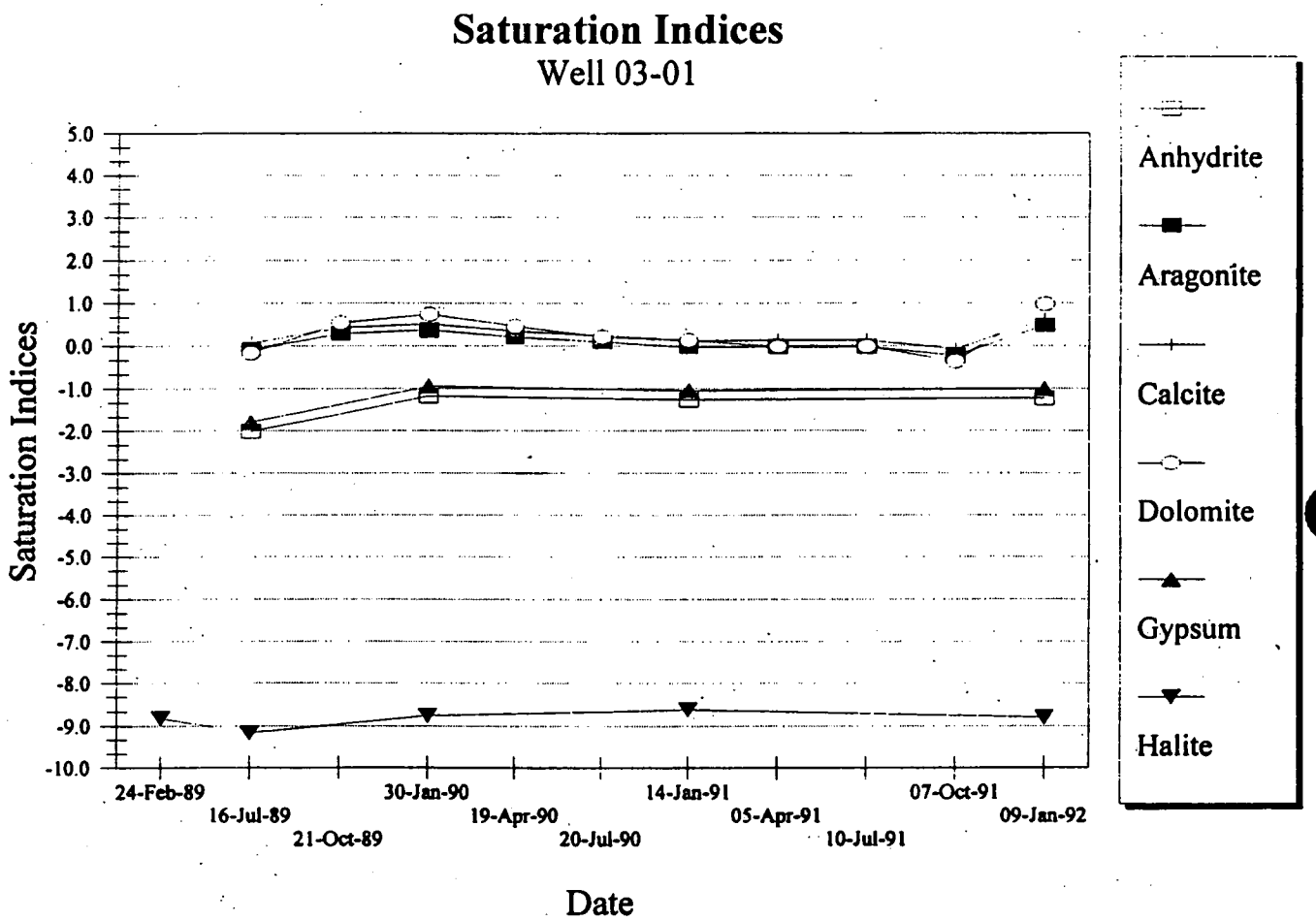
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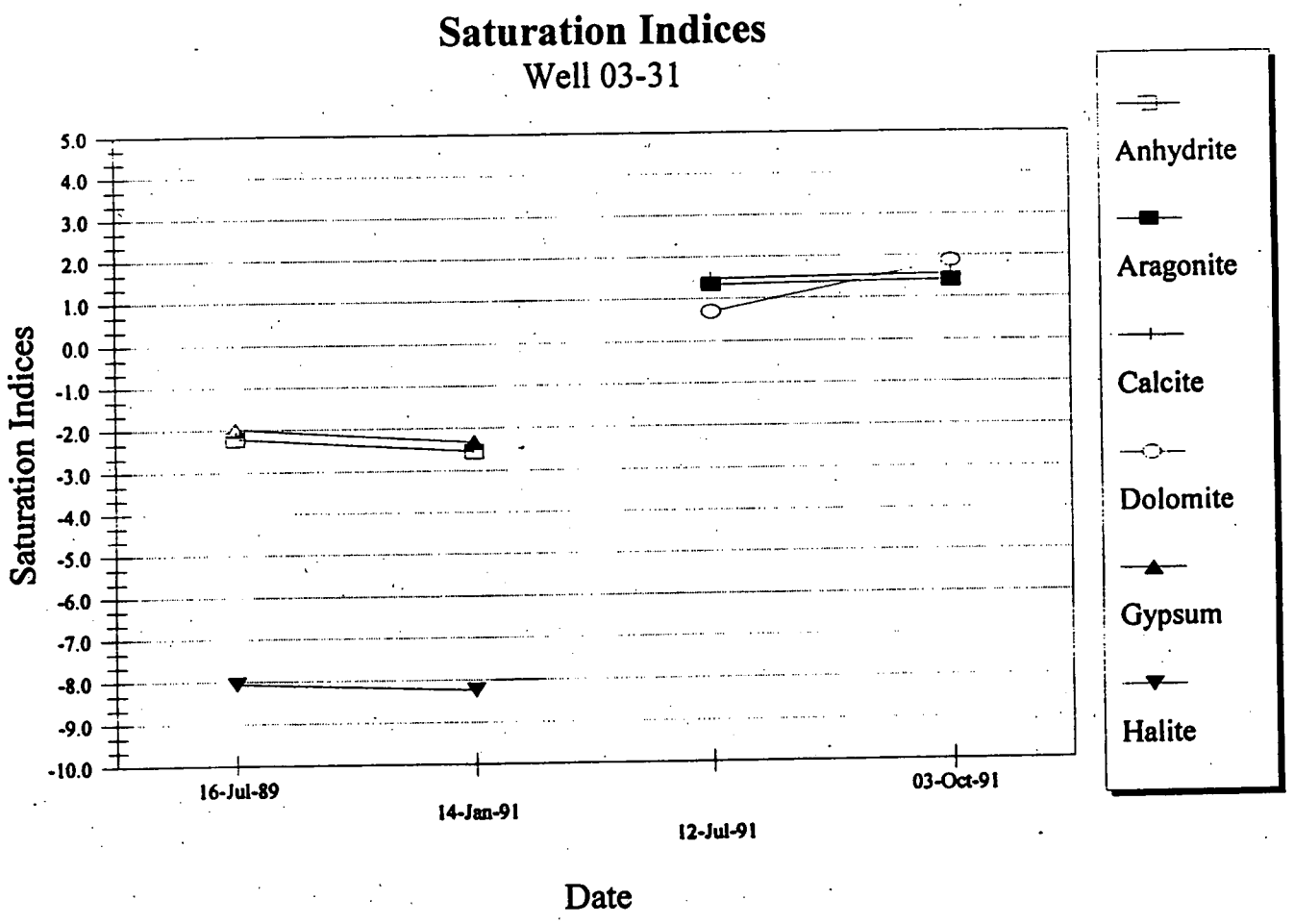
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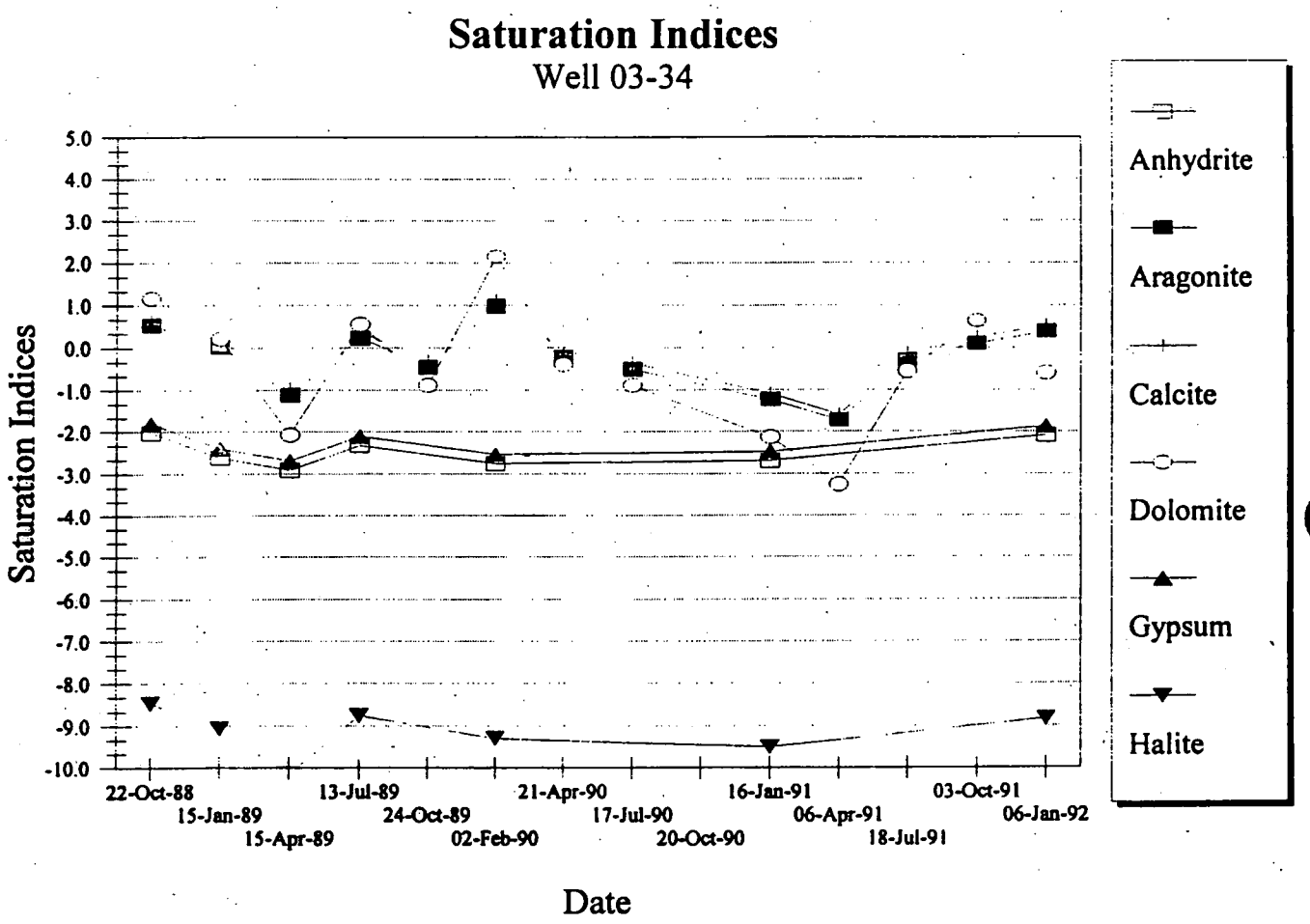
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-9.0
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15-Apr-89
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02-Feb-90
21-Apr-90
17-Jul-90
20-Oct-90
16-Jan-91
06-Apr-91
18-Jul-91
03-Oct-91
06-Jan-92
Date
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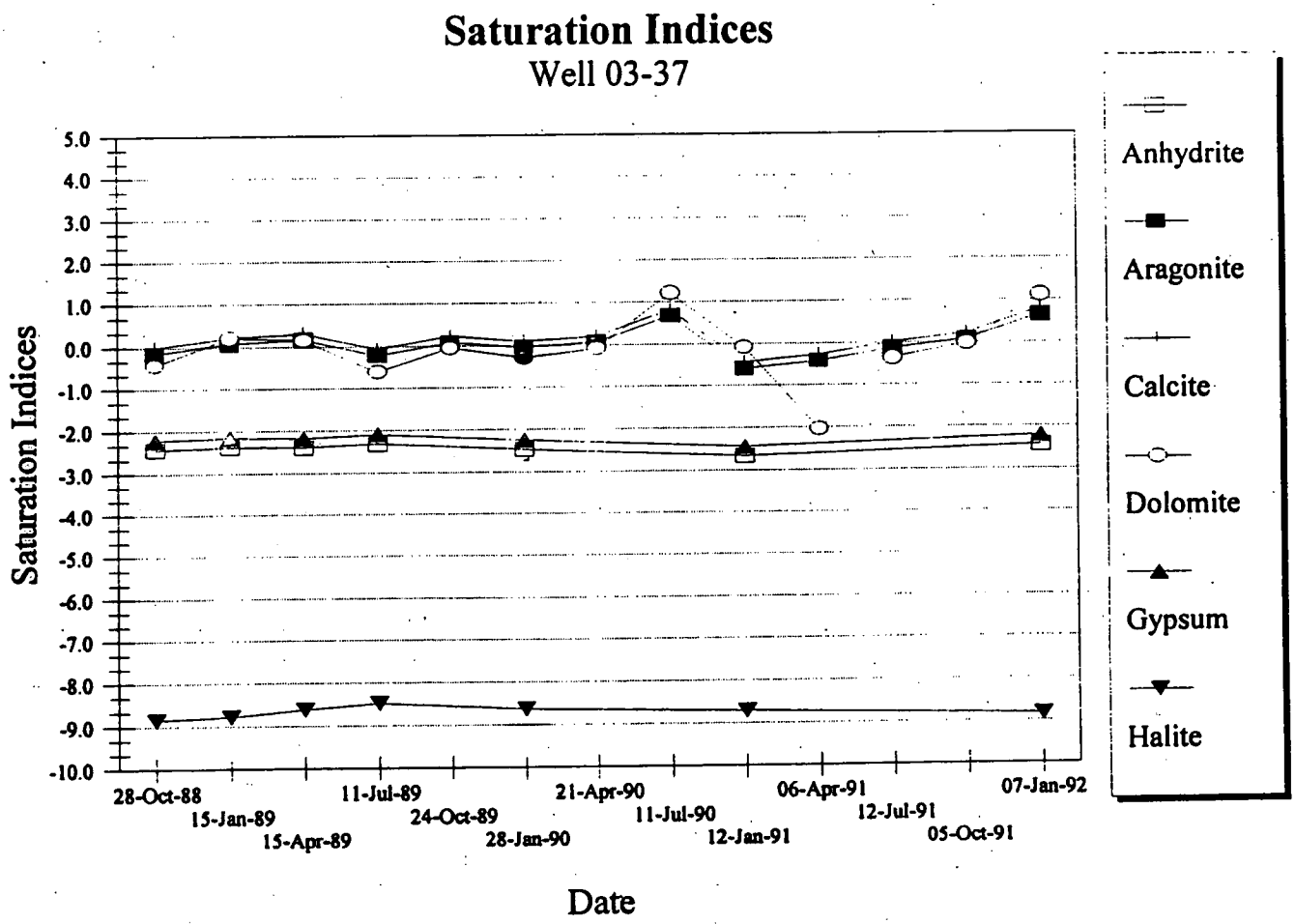
Aragonite
Calcite
Dolomite
Gypsum
Halite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11-Jul-90
12-Jan-91
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07-Jan-92
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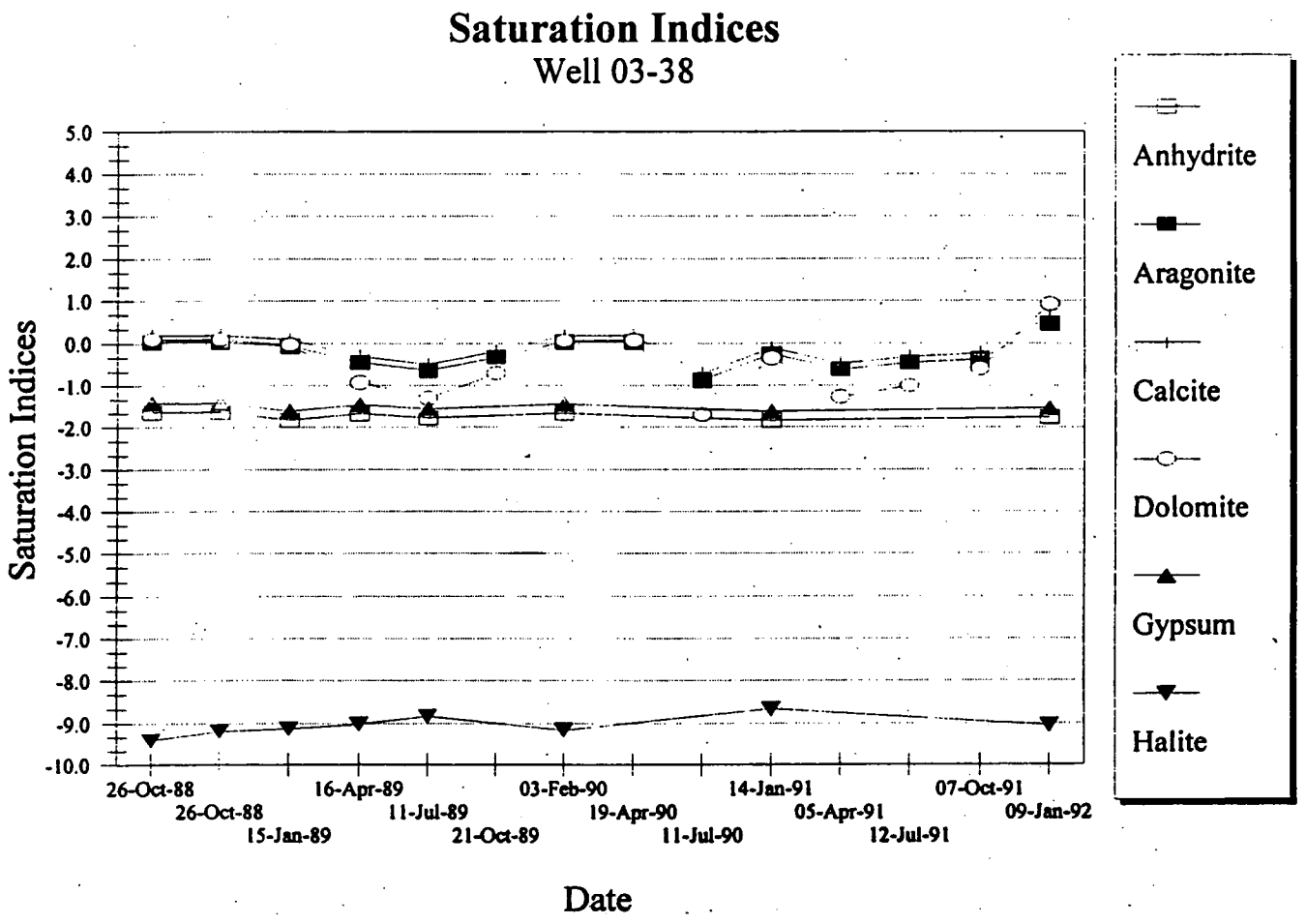
Aragonite
Calcite
Dolomite
Gypsum
Halite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11-Jul-90
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07-Oct-91
09-Jan-92
Date
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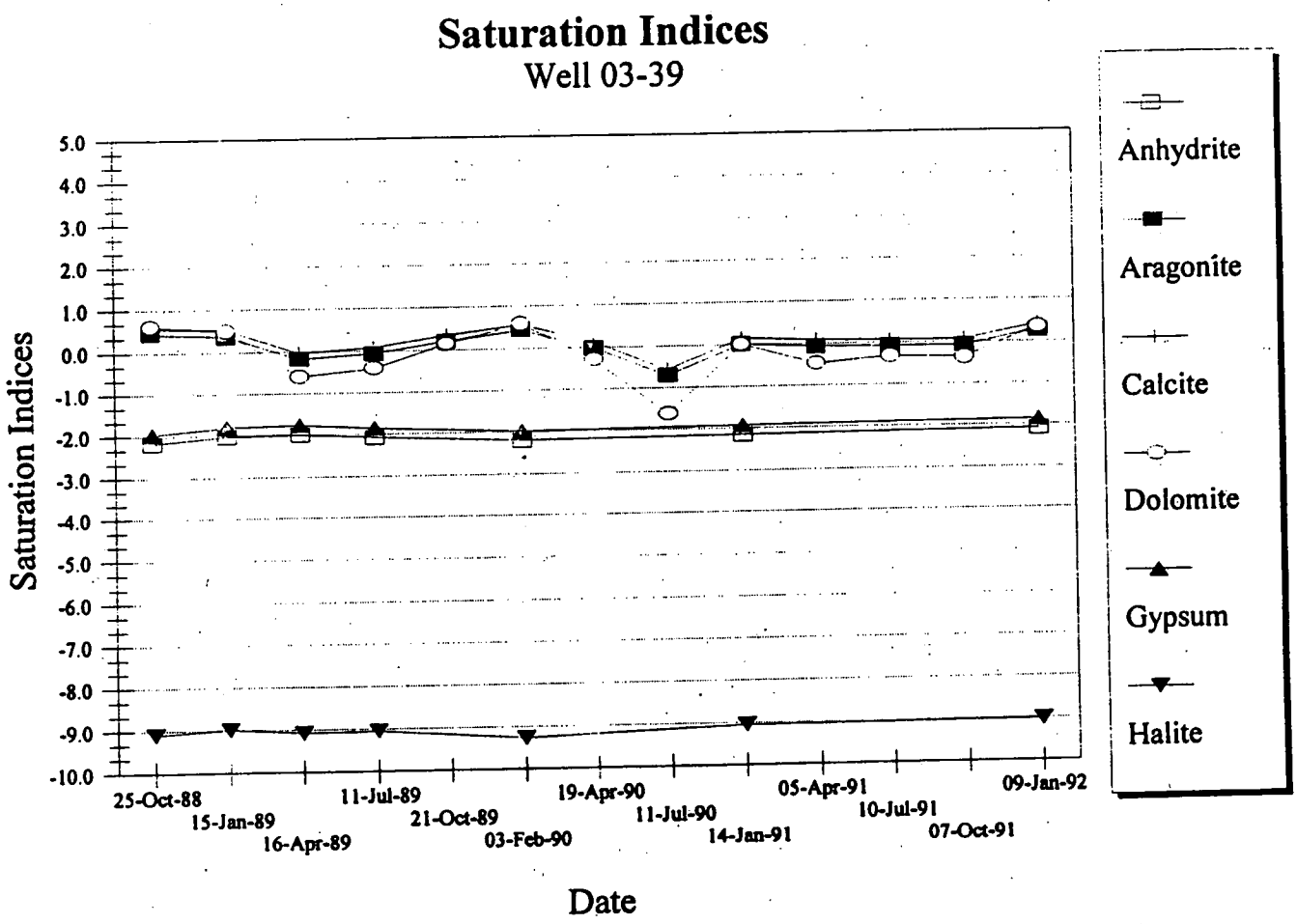
Aragonite
Calcite
Dolomite
Gypsum
Halite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11-Jul-90
14-Jan-91
05-Apr-91
10-Jul-91
07-Oct-91
09-Jan-92
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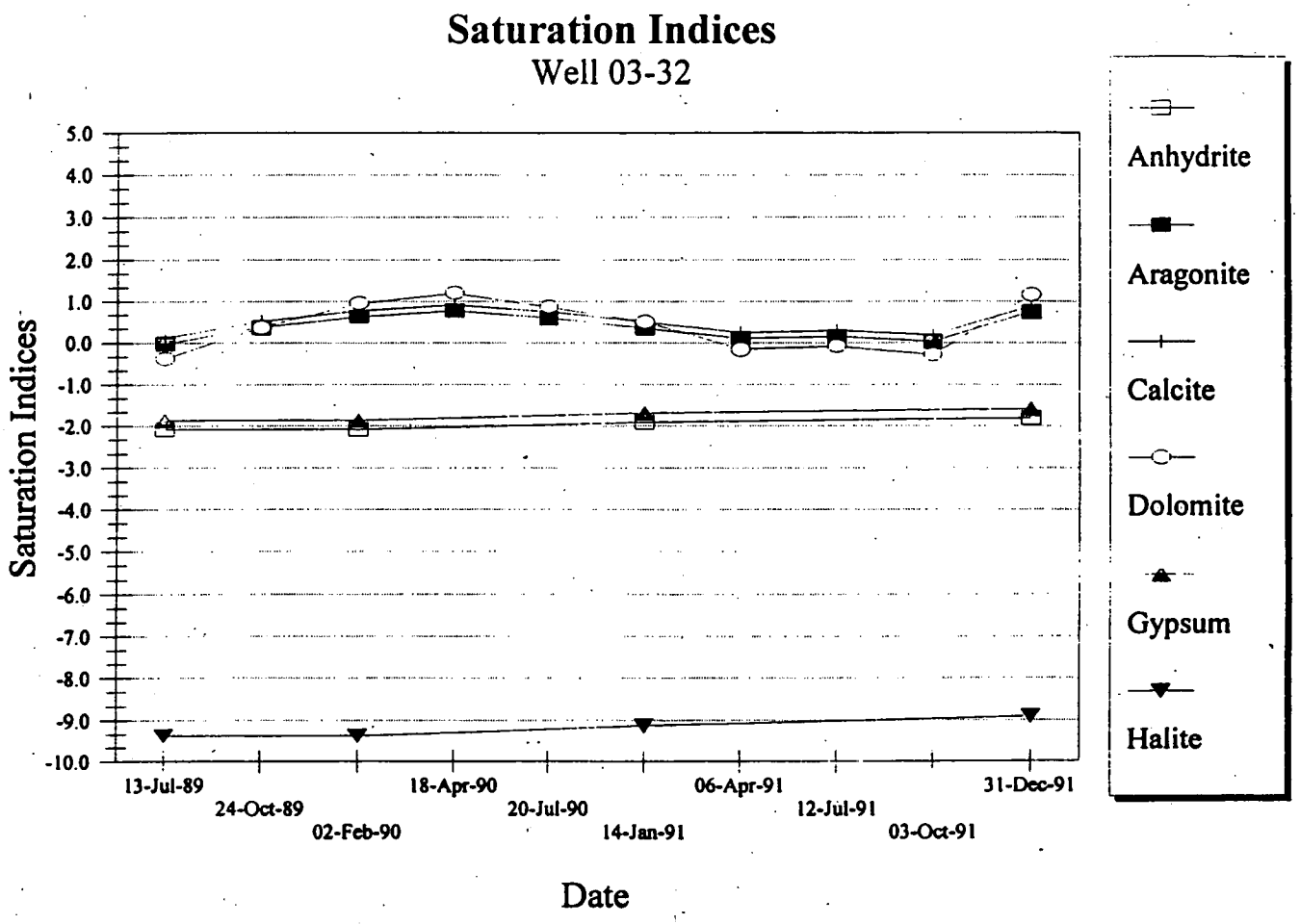
Aragonite
Calcite
Dolomite
Gypsum
Halite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-2.0
-3.0
-4.0
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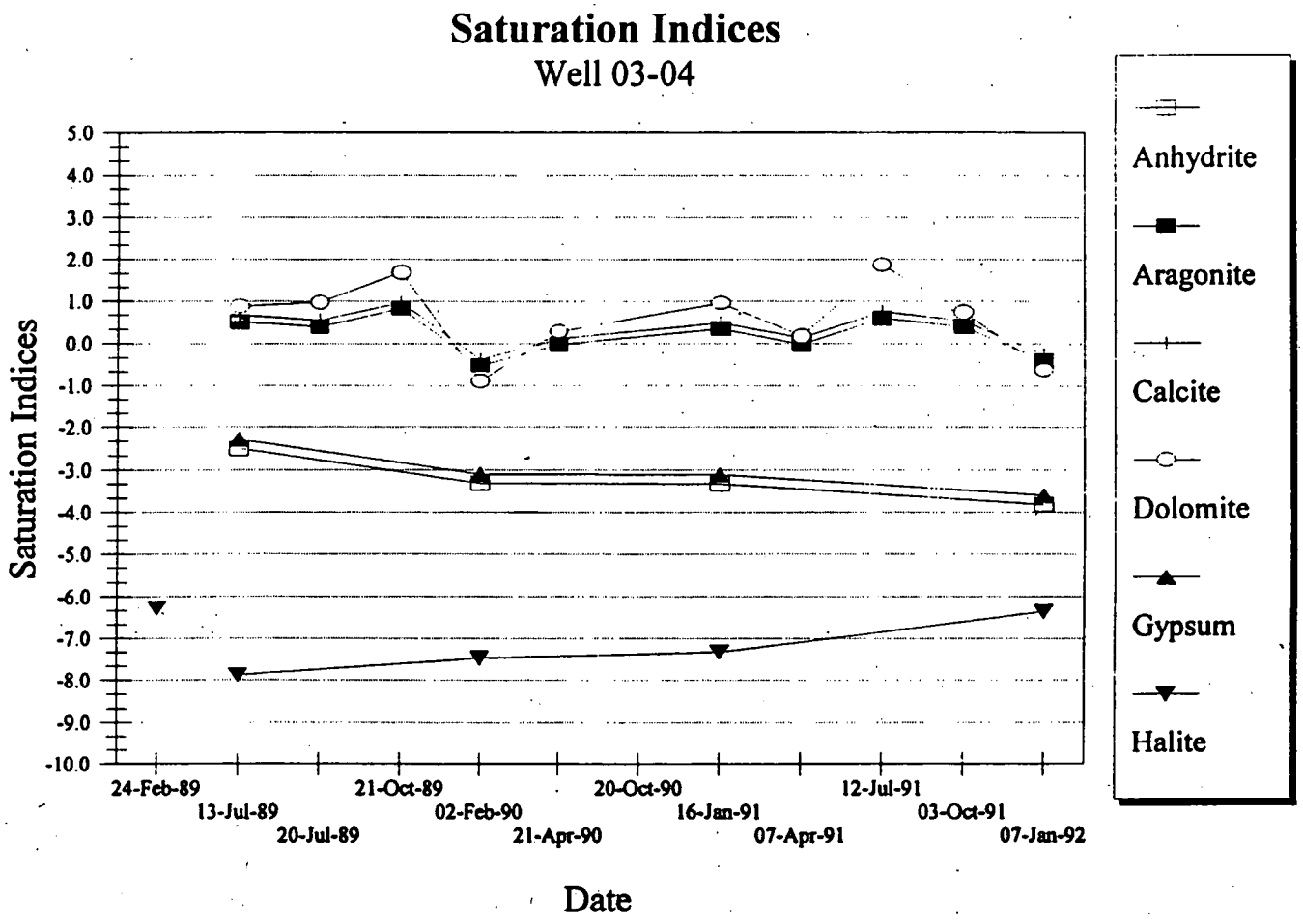
-6.0
-7.0
-8.0
-9.0
-10.0
13-Jul-89
24-Oct-89
02-Feb-90
18-Apr-90
20-Jul-90
14-Jan-91
06-Apr-91
12-Jul-91
03-Oct-91
31-Dec-91
Date
Anhydrite
Aragonite
Calcite
Dolomite
Gypsum
Halite

Appendix 2.3

Speciation Model Results for Wells Screened in the Beech Creek Aquifer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24-Feb-89
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21-Oct-89
02-Feb-90
21-Apr-90
20-Oct-90
16-Jan-91
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12-Jul-91
03-Oct-91
07-Jan-92
Date
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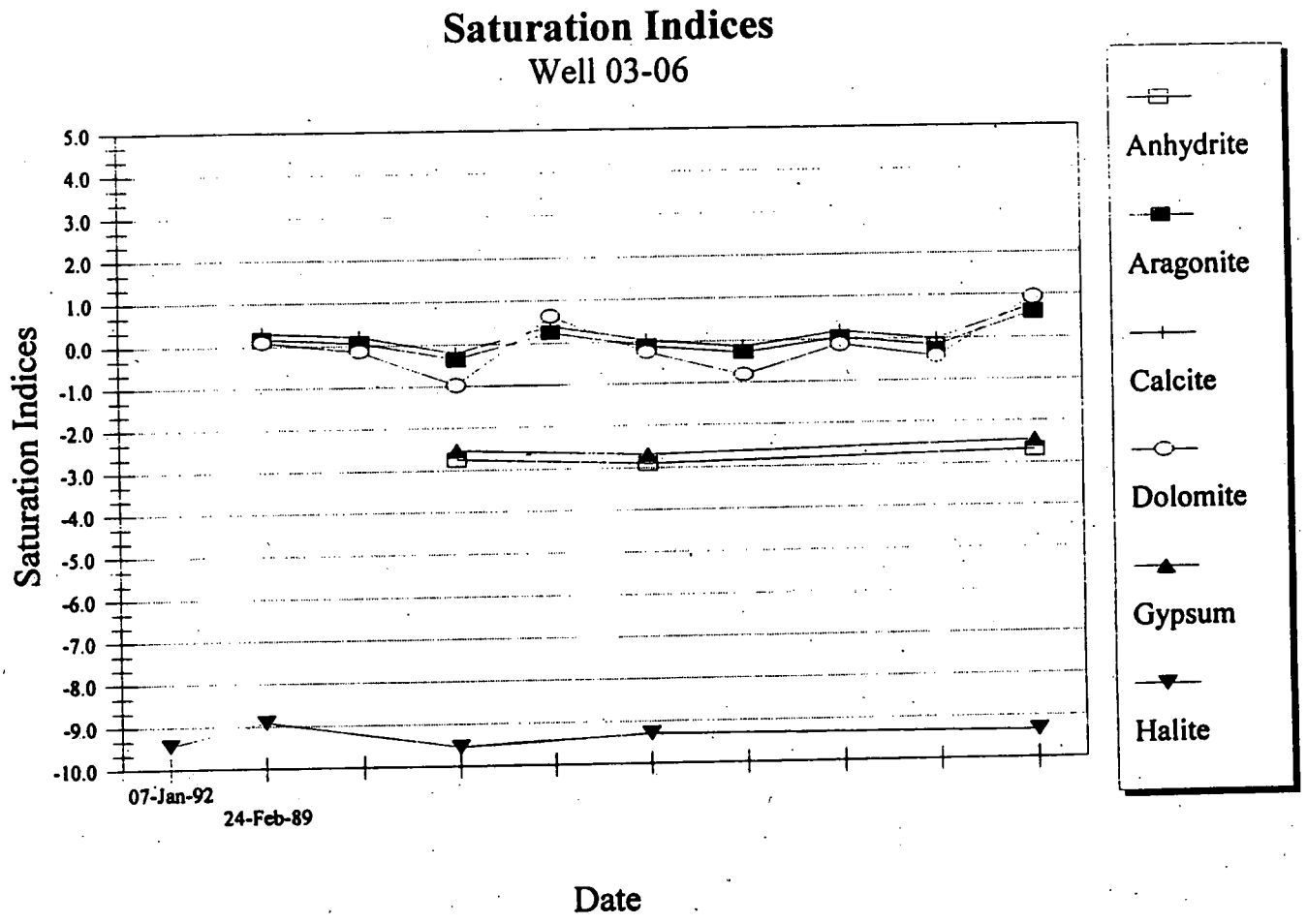
Aragonite
Calcite
Dolomite
Gypsum
Halite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-7.0
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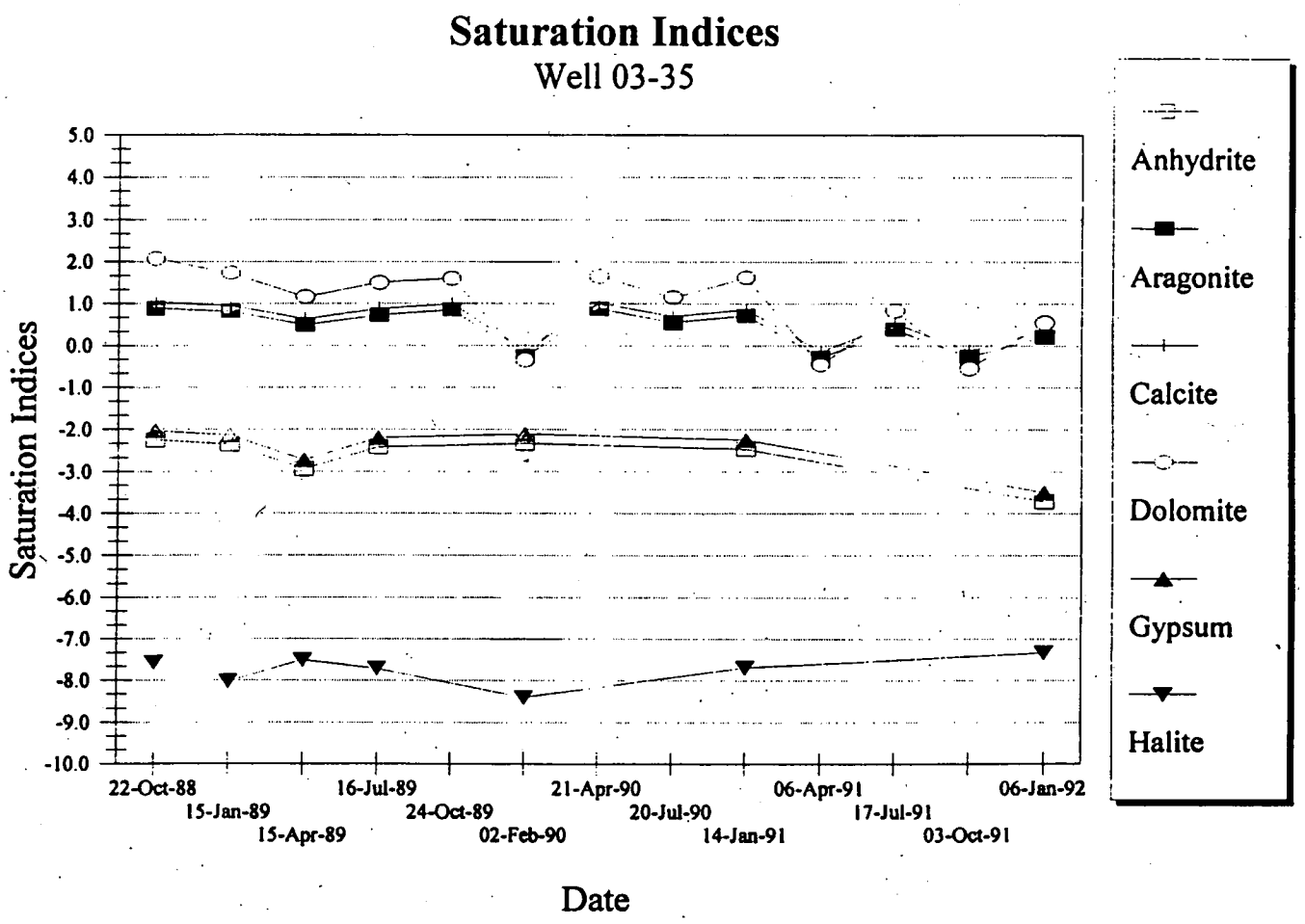
24-Feb-89
Date
Anhydrite
Aragonite
Calcite
Dolomite
Gypsum
Halite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-6.0
-7.0
-8.0
-9.0
-10.0
22-Oct-88
15-Jan-89
15-Apr-89
16-Jul-89
24-Oct-89
02-Feb-90
21-Apr-90
20-Jul-90
14-Jan-91
06-Apr-91
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03-Oct-91
06-Jan-92
Date
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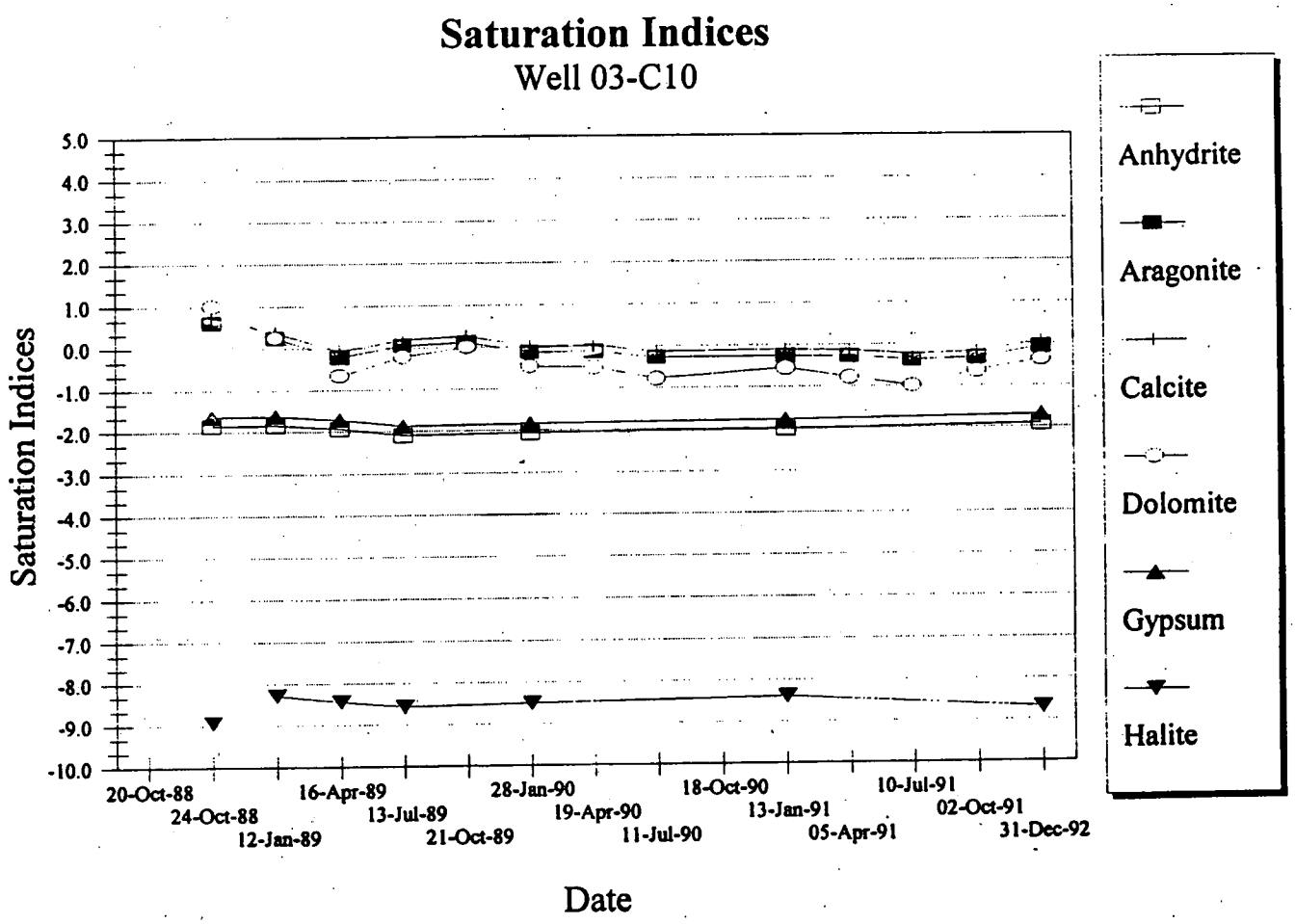
Aragonite
Calcite
Dolomite
Gypsum
Halite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-6.0
-7.0
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-9.0
-10.0
20-Oct-88
24-Oct-88
12-Jan-89
16-Apr-89
13-Jul-89
21-Oct-89
28-Jan-90
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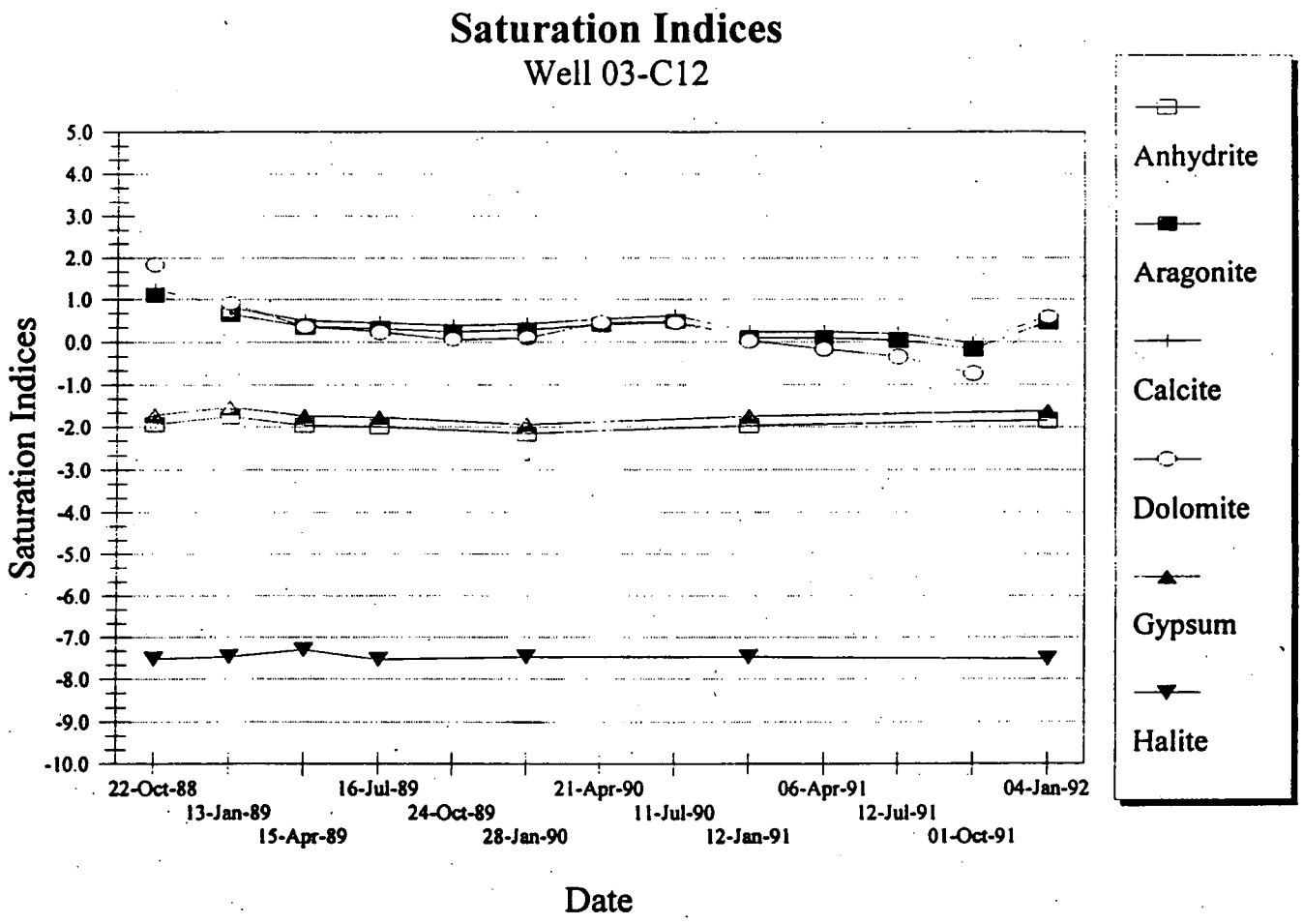
02-Oct-91
31-Dec-92
Date
Anhydrite
Aragonite
Calcite
Dolomite
Gypsum
Halite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-9.0
-10.0
22-Oct-88
13-Jan-89
15-Apr-89
16-Jul-89
24-Oct-89
28-Jan-90
21-Apr-90
11-Jul-90
12-Jan-91
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01-Oct-91
04-Jan-92
Date
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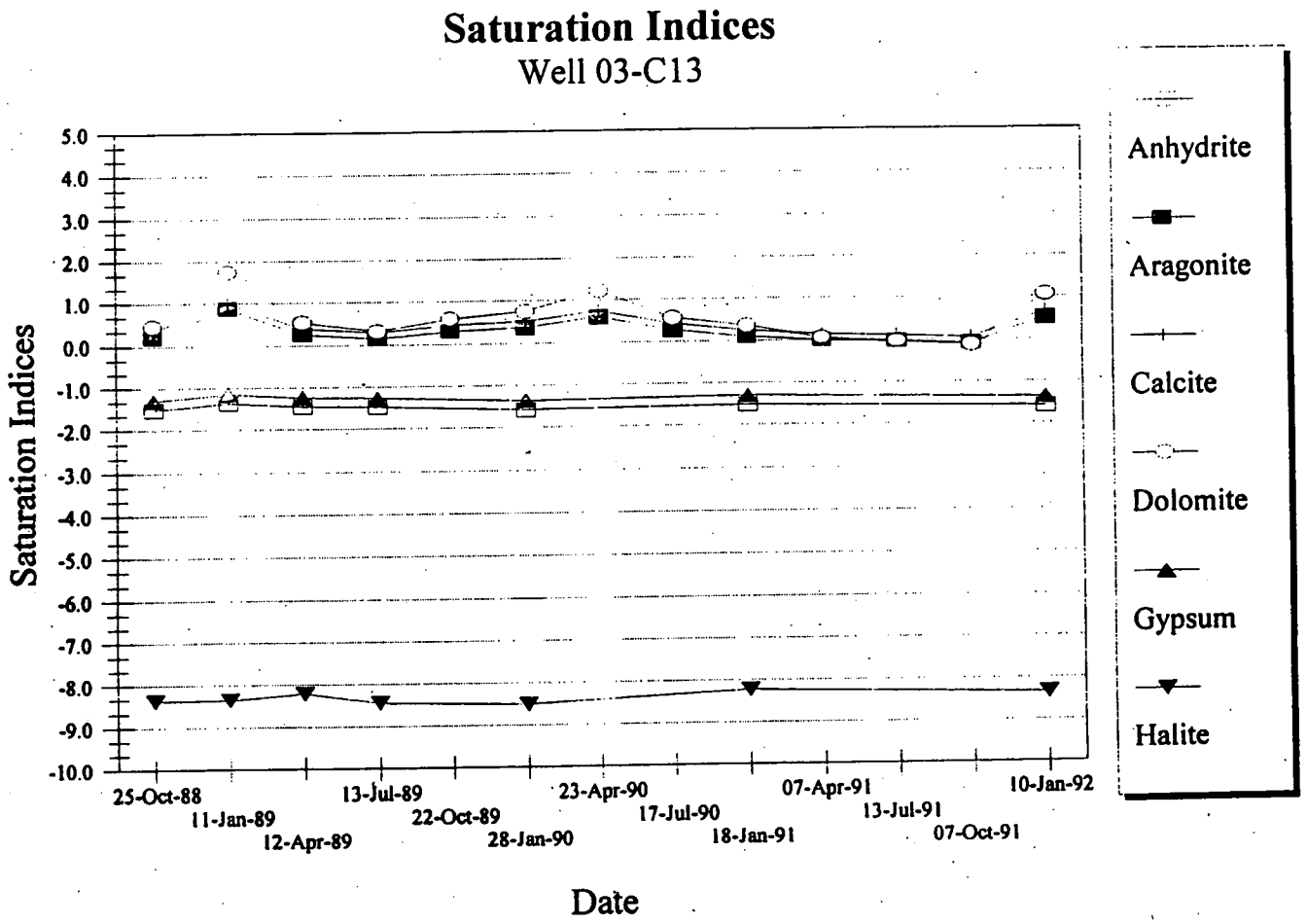
Aragonite
Calcite
Dolomite
Gypsum
Halite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07-Oct-91
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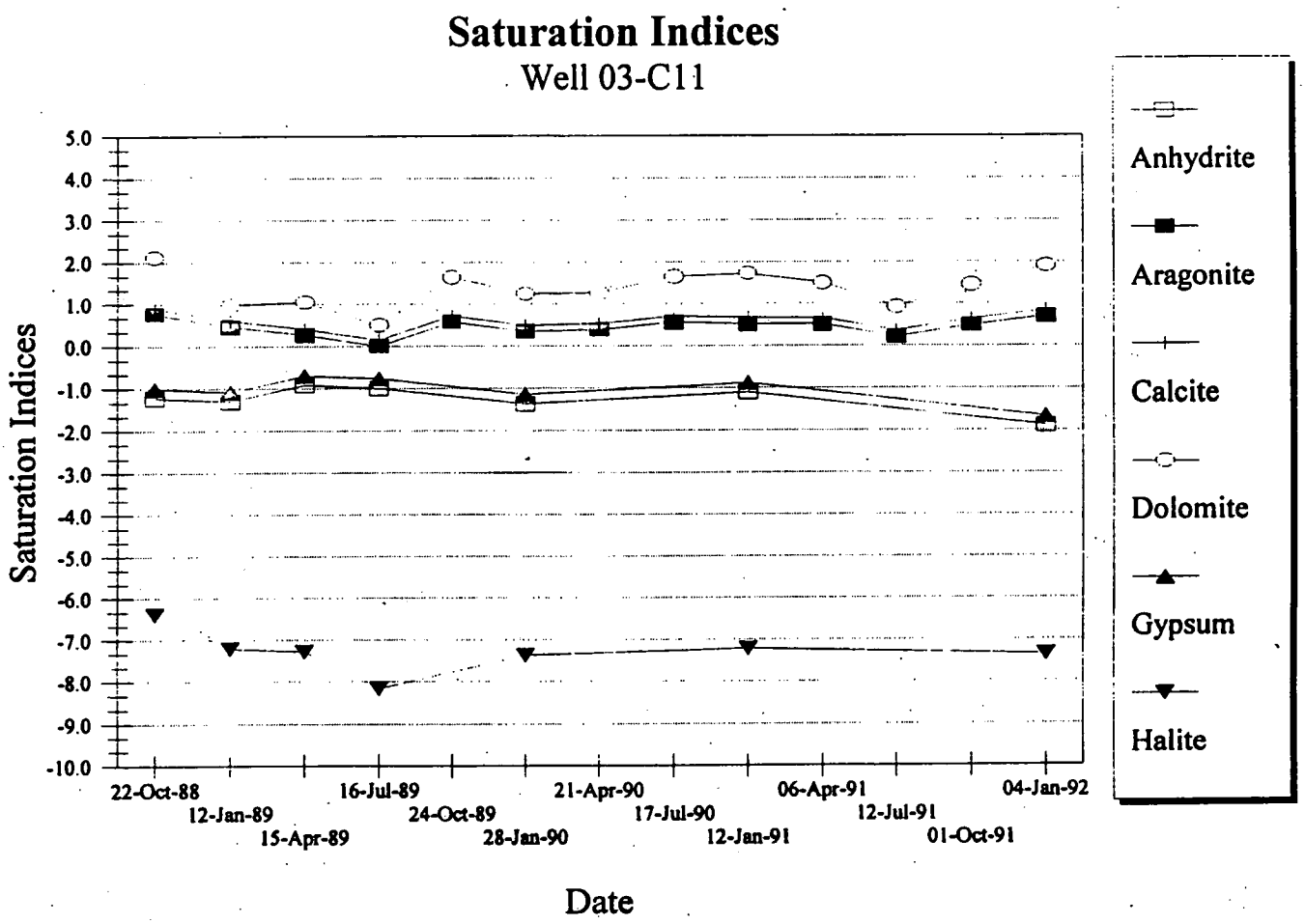
Calcite
Dolomite
Gypsum
Halite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12-Jan-89
15-Apr-89
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24-Oct-89
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21-Apr-90
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01-Oct-91
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Date
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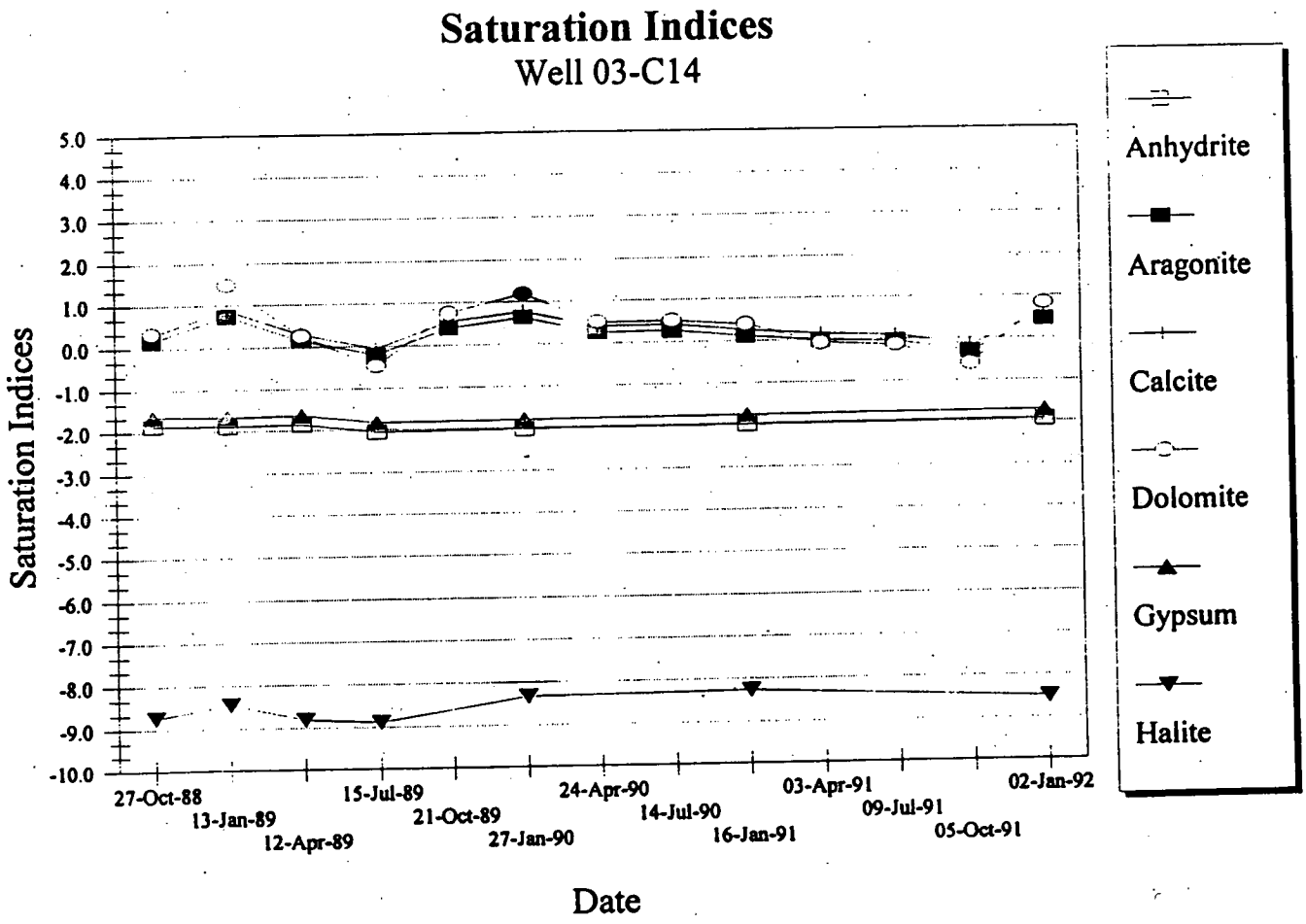
Aragonite
Calcite
Dolomite
Gypsum
Halite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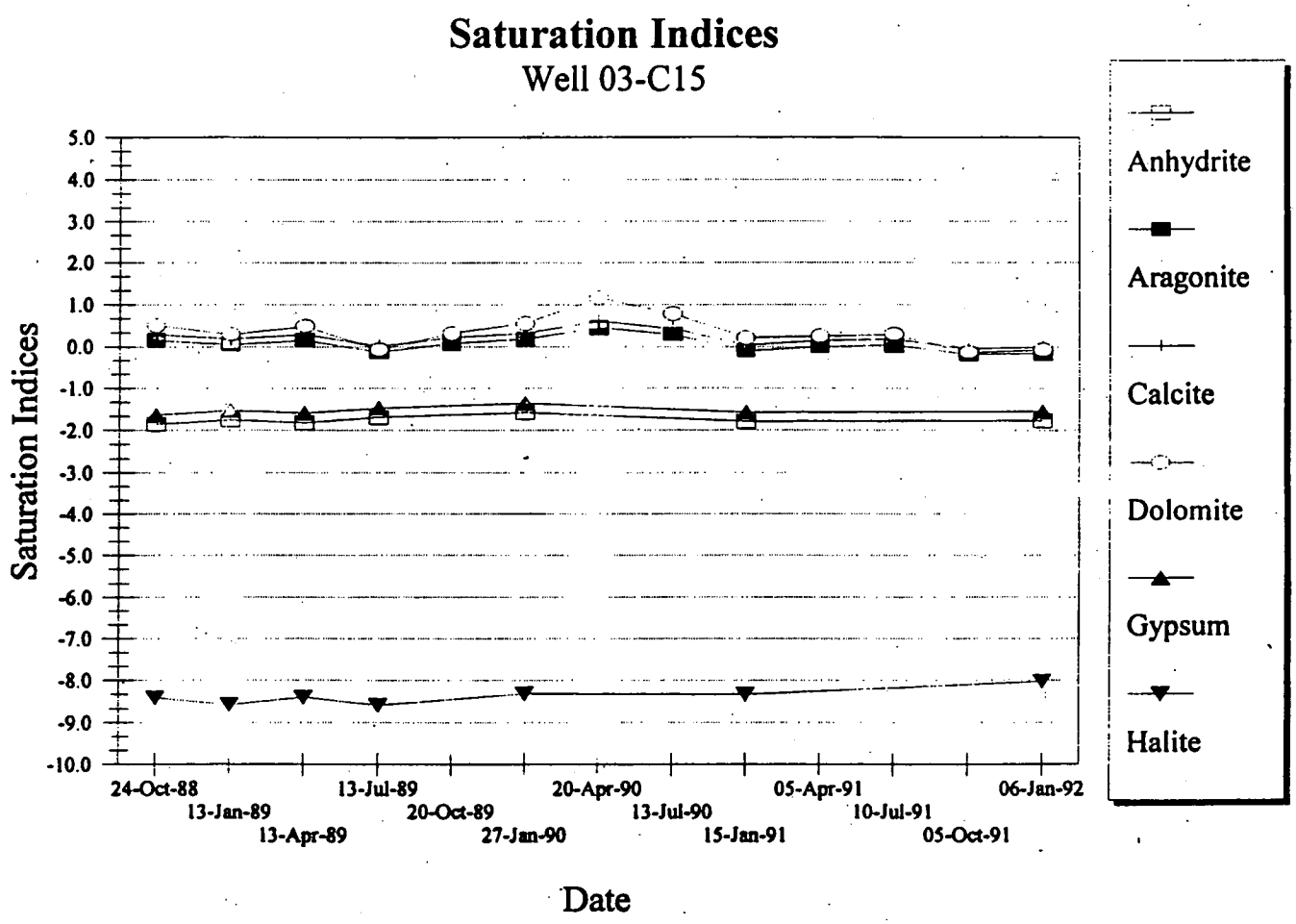
Aragonite
Calcite
Dolomite
Gypsum
Halite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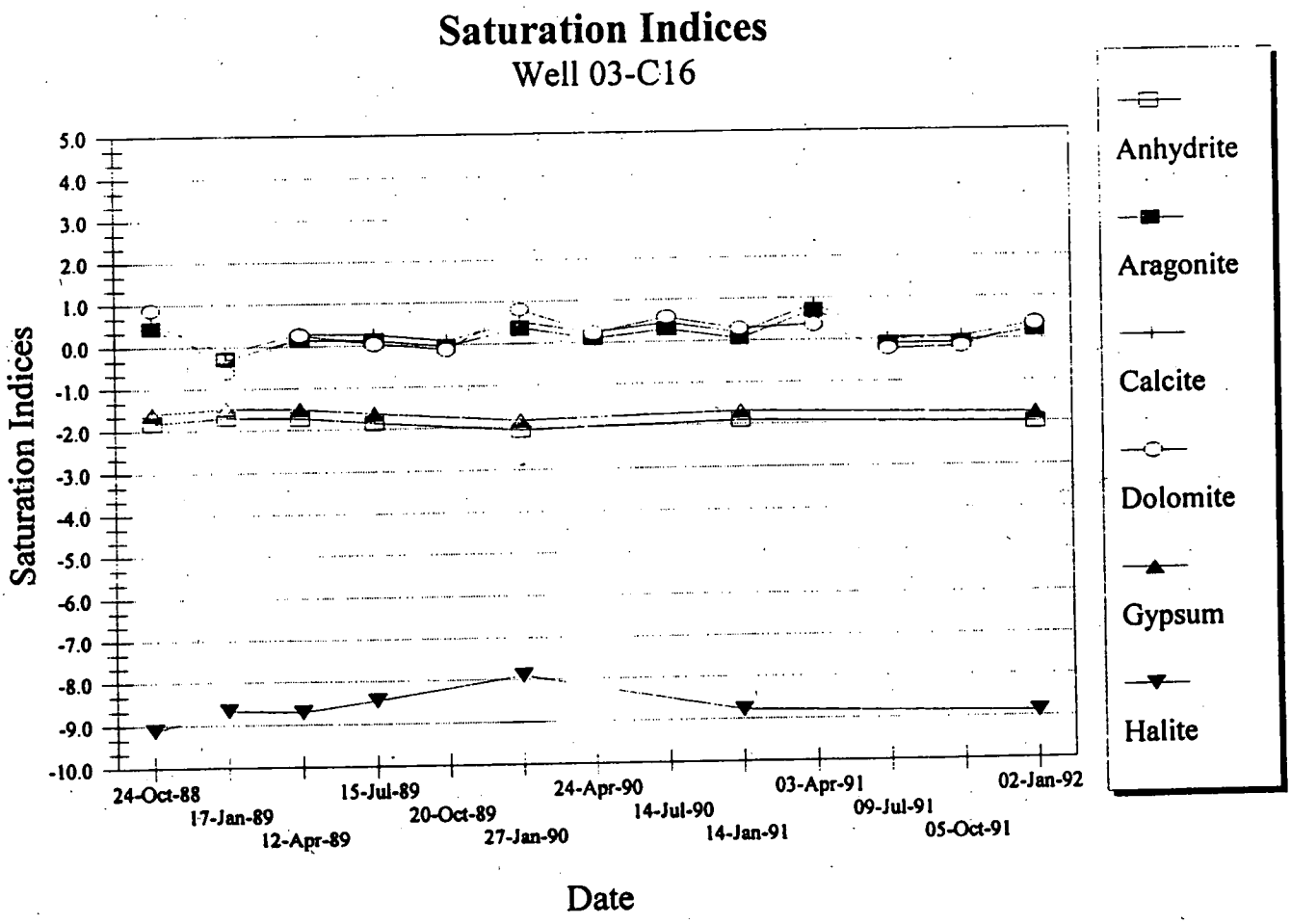
Calcite
Dolomite
Gypsum
Halite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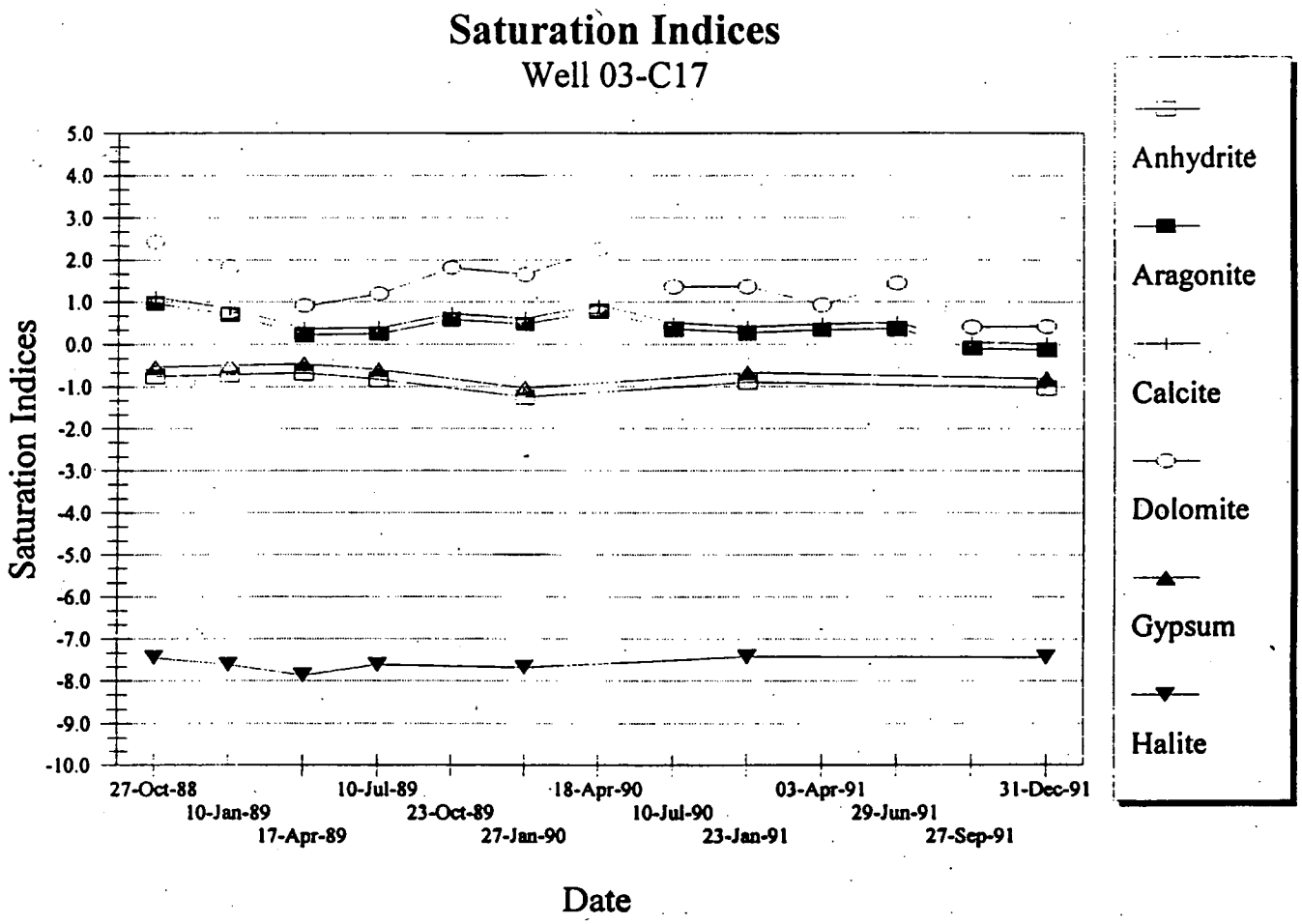
Calcite
Dolomite
Gypsum
Halite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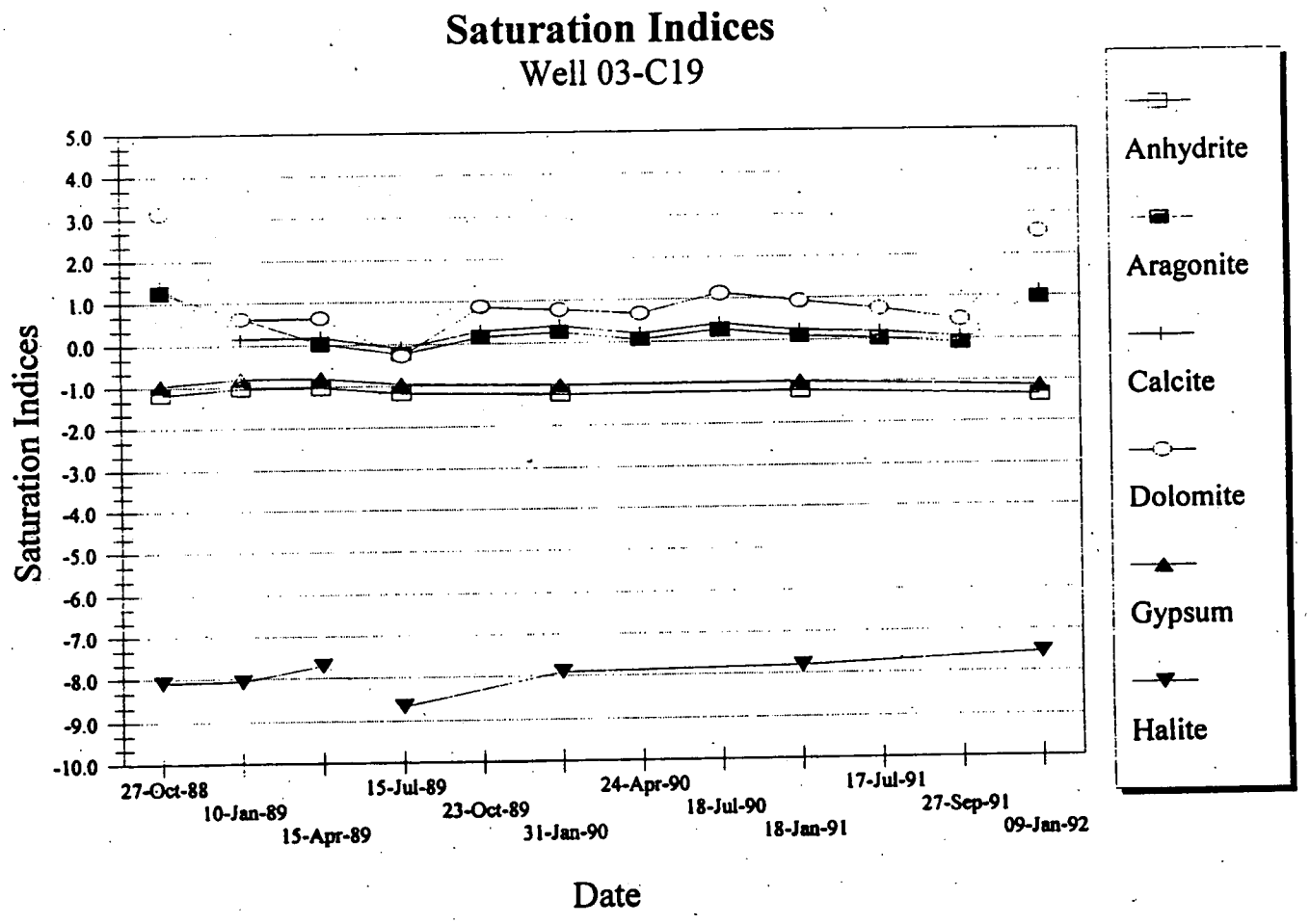
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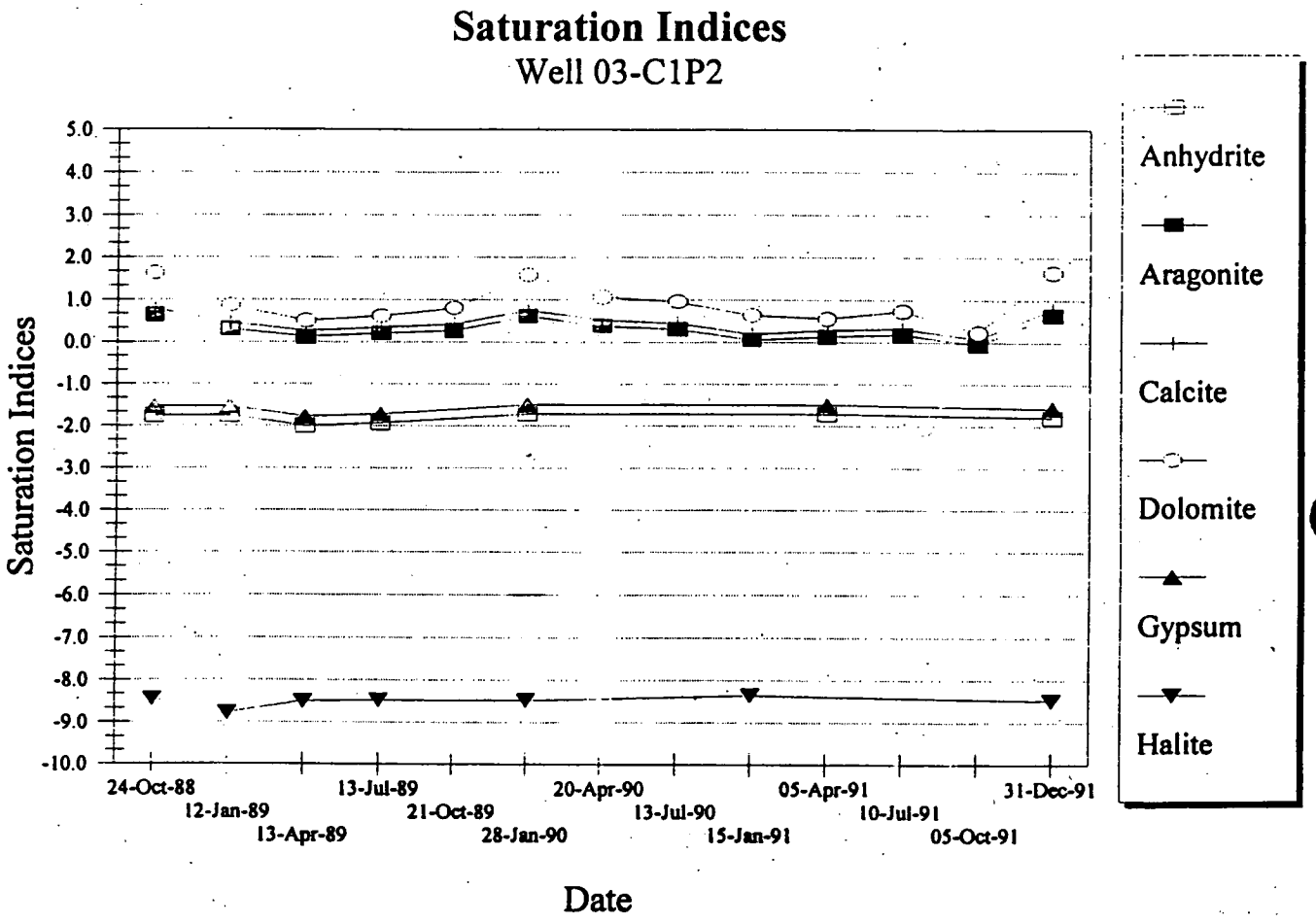
Dolomite
Gypsum
Halite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13-Jul-90
15-Jan-91
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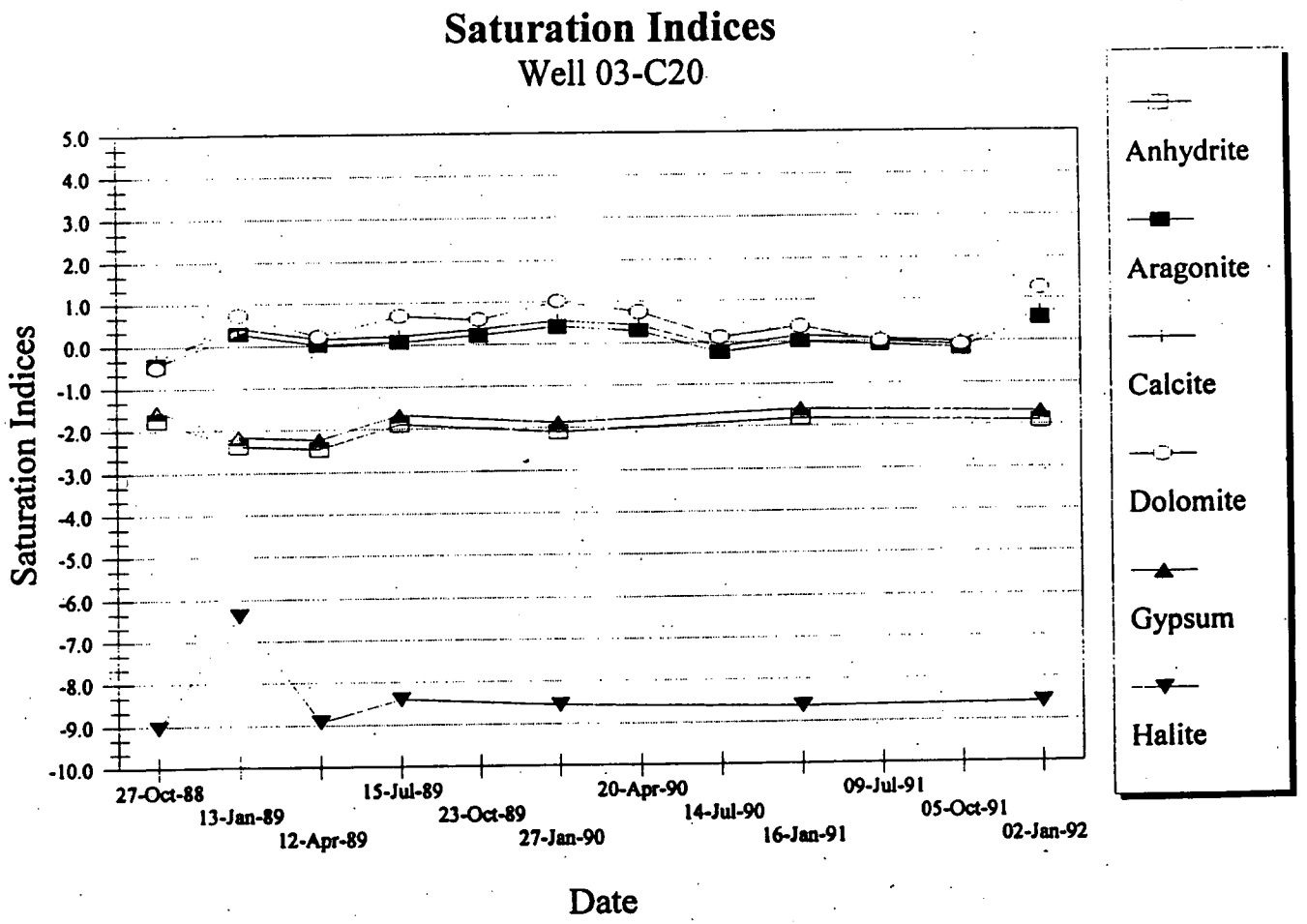
Aragonite
Calcite
Dolomite
Gypsum
Halite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14-Jul-90
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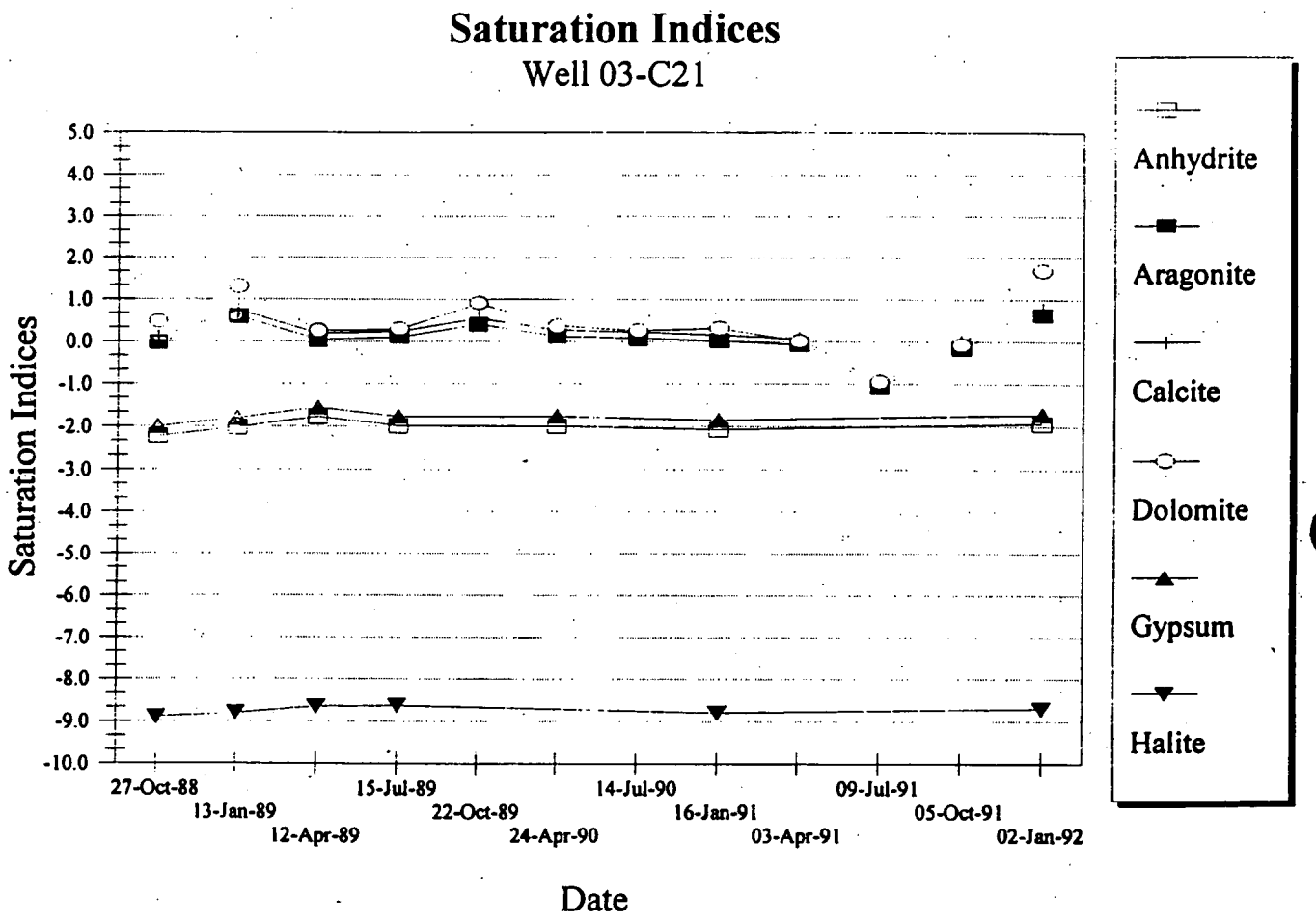
Aragonite
Calcite
Dolomite
Gypsum
Halite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16-Jan-91
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02-Jan-92
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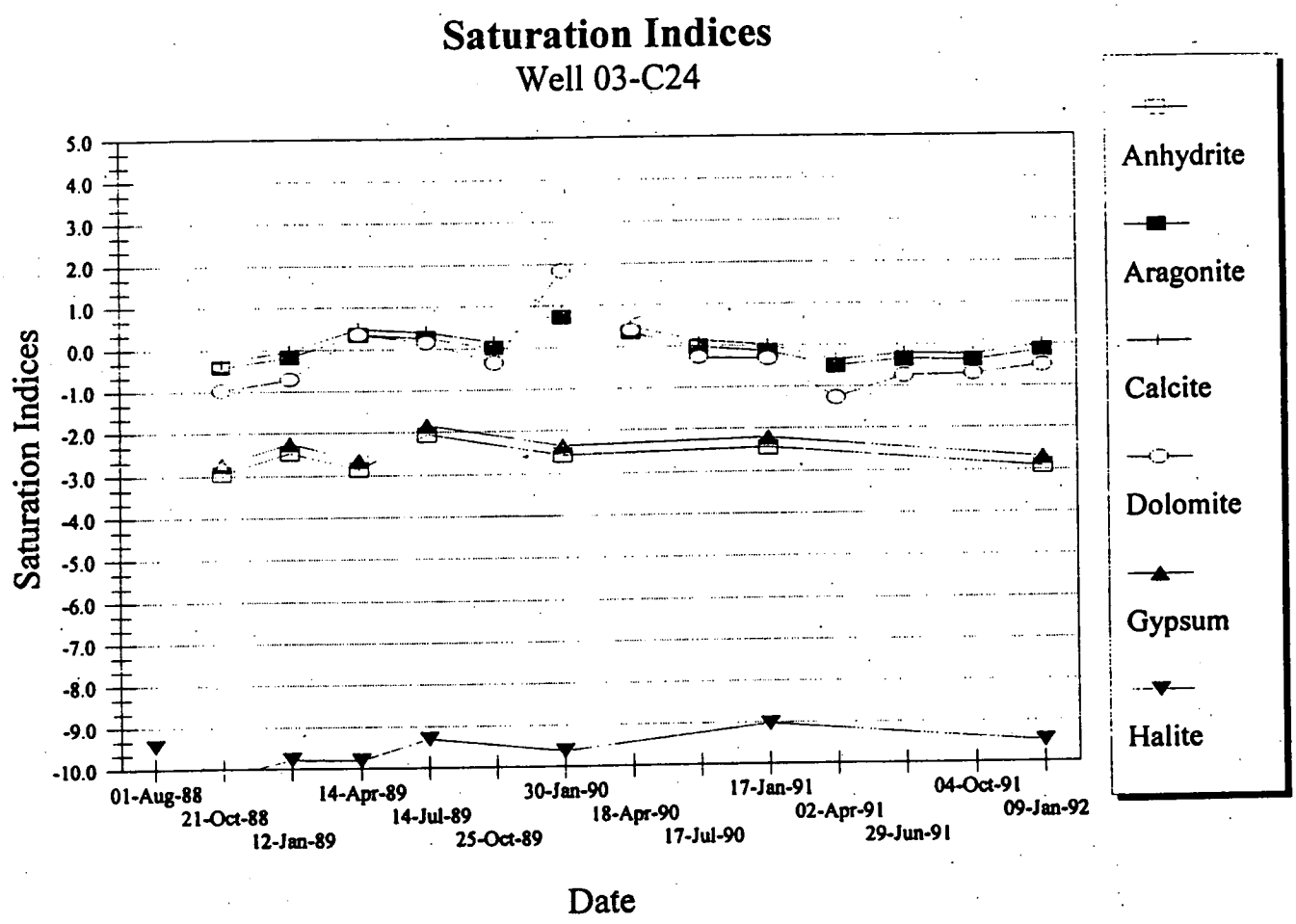
Aragonite
Calcite
Dolomite
Gypsum
Halite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25-Oct-89
30-Jan-90
18-Apr-90
17-Jul-90
17-Jan-91
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04-Oct-91
09-Jan-92
Date
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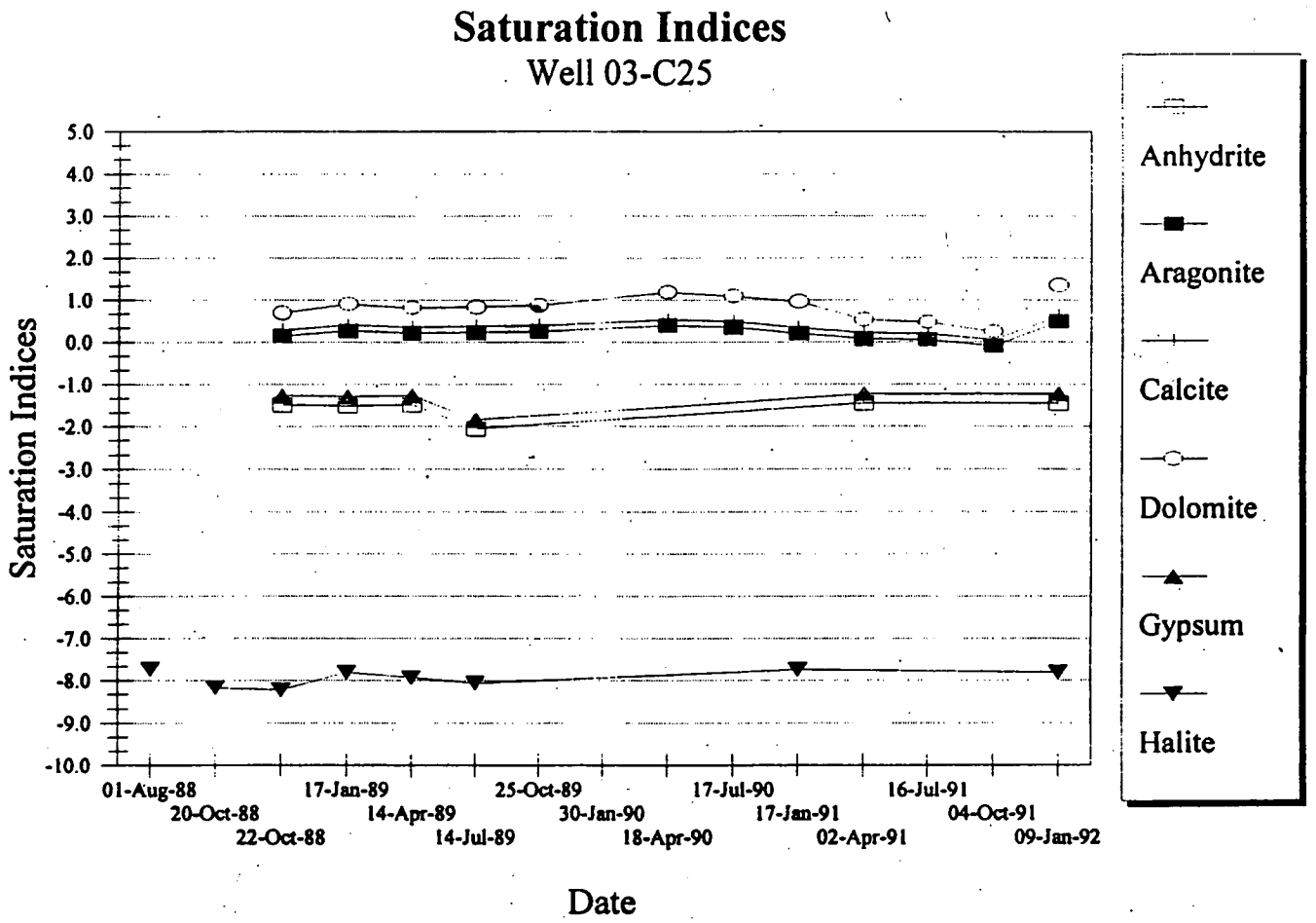
Aragonite
Calcite
Dolomite
Gypsum
Halite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17-Jan-91
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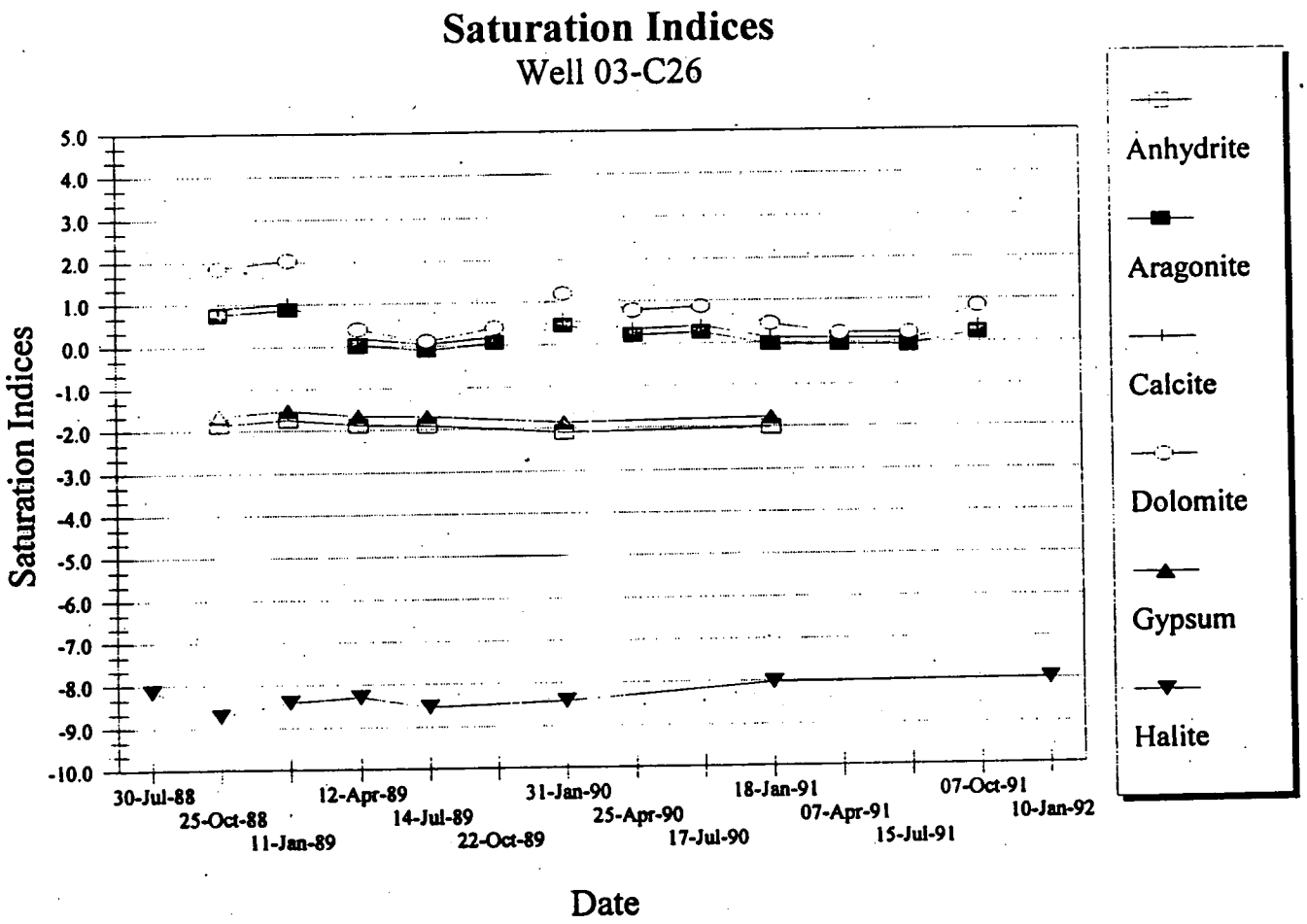
Aragonite
Calcite
Dolomite
Gypsum
Halite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11-Jan-89
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22-Oct-89
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18-Jan-91
07-Apr-91
15-Jul-91
07-Oct-91
10-Jan-92
Date
Anhydrite
Aragonite
Calcite
Dolomite
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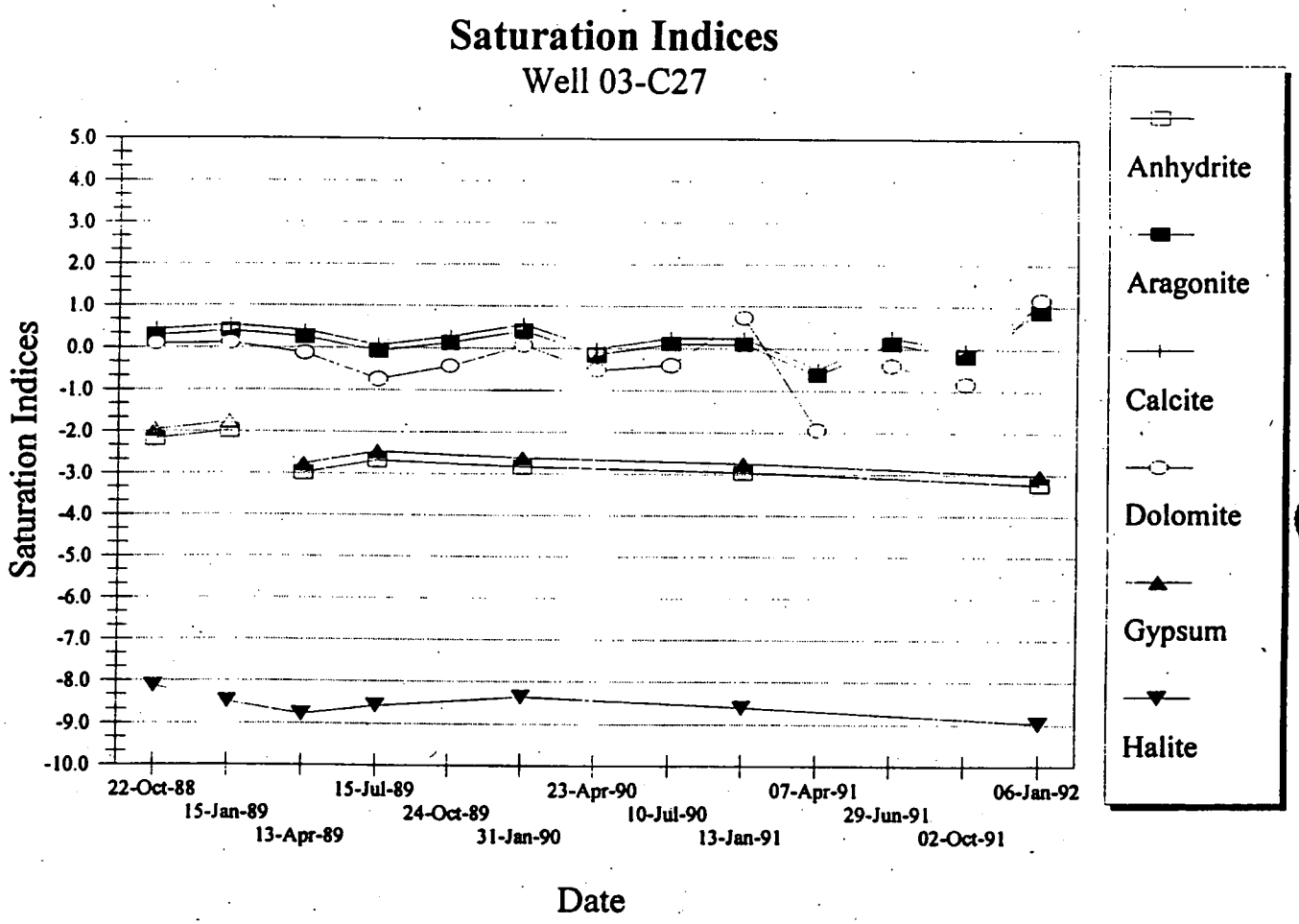
Halite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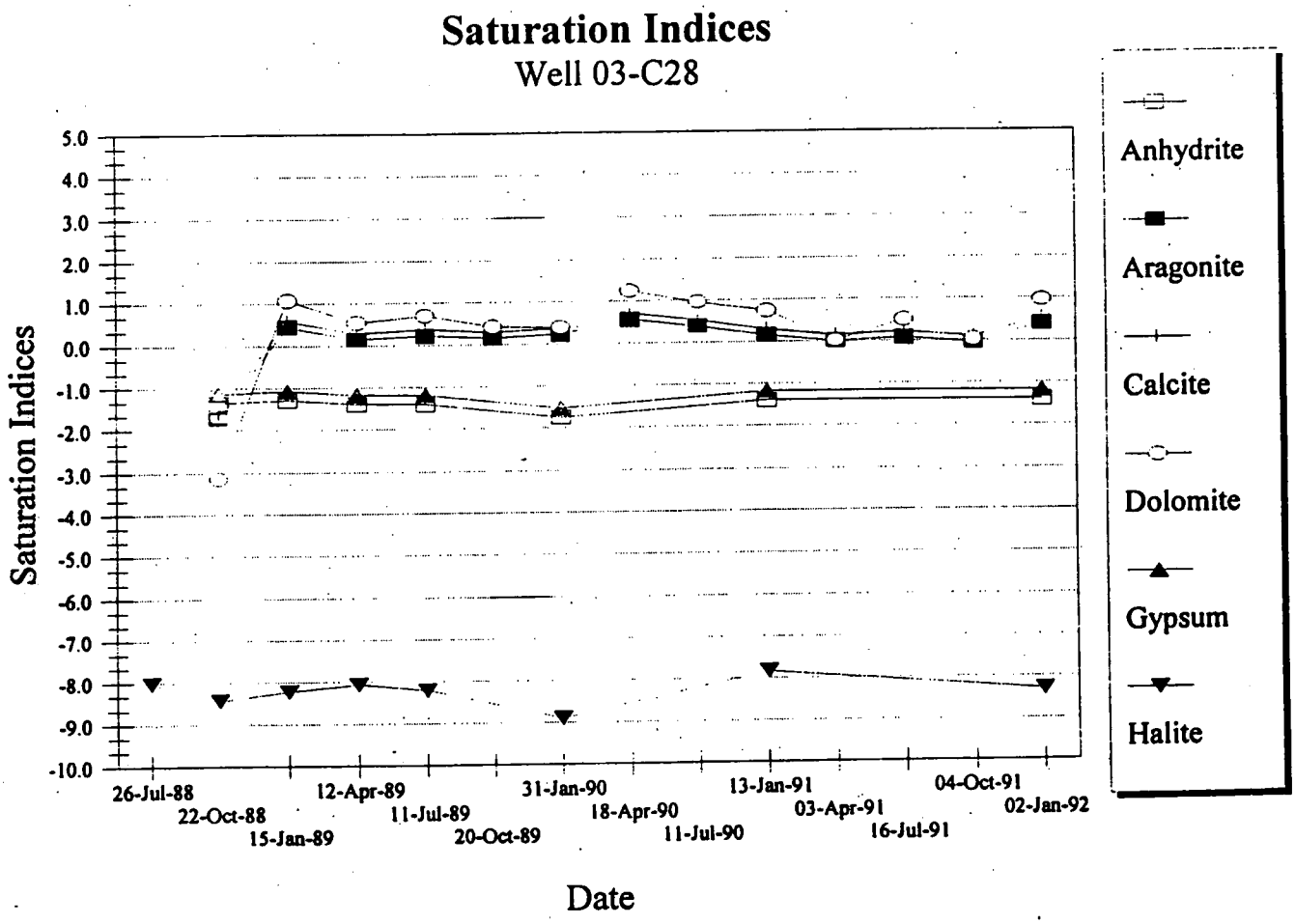
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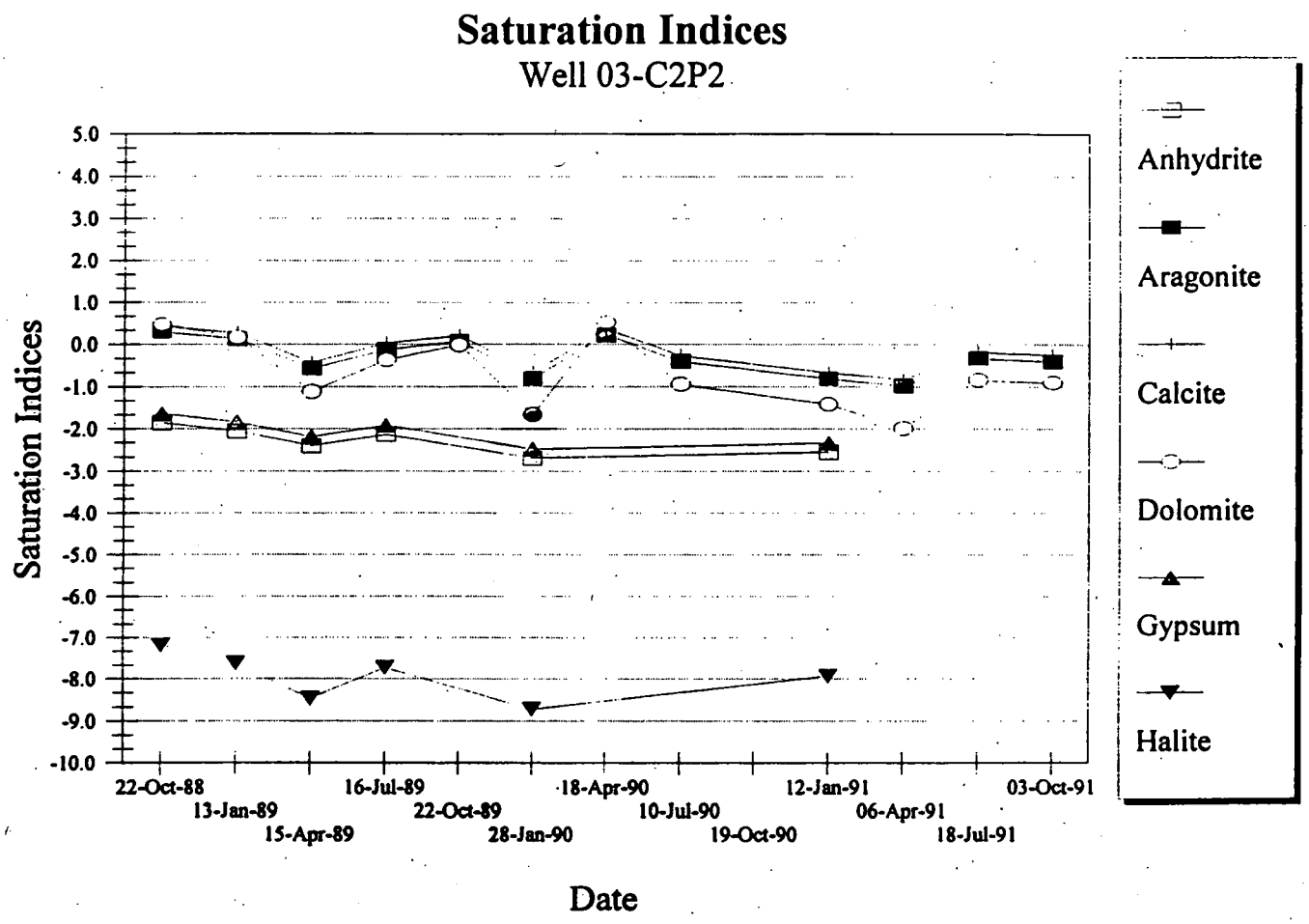
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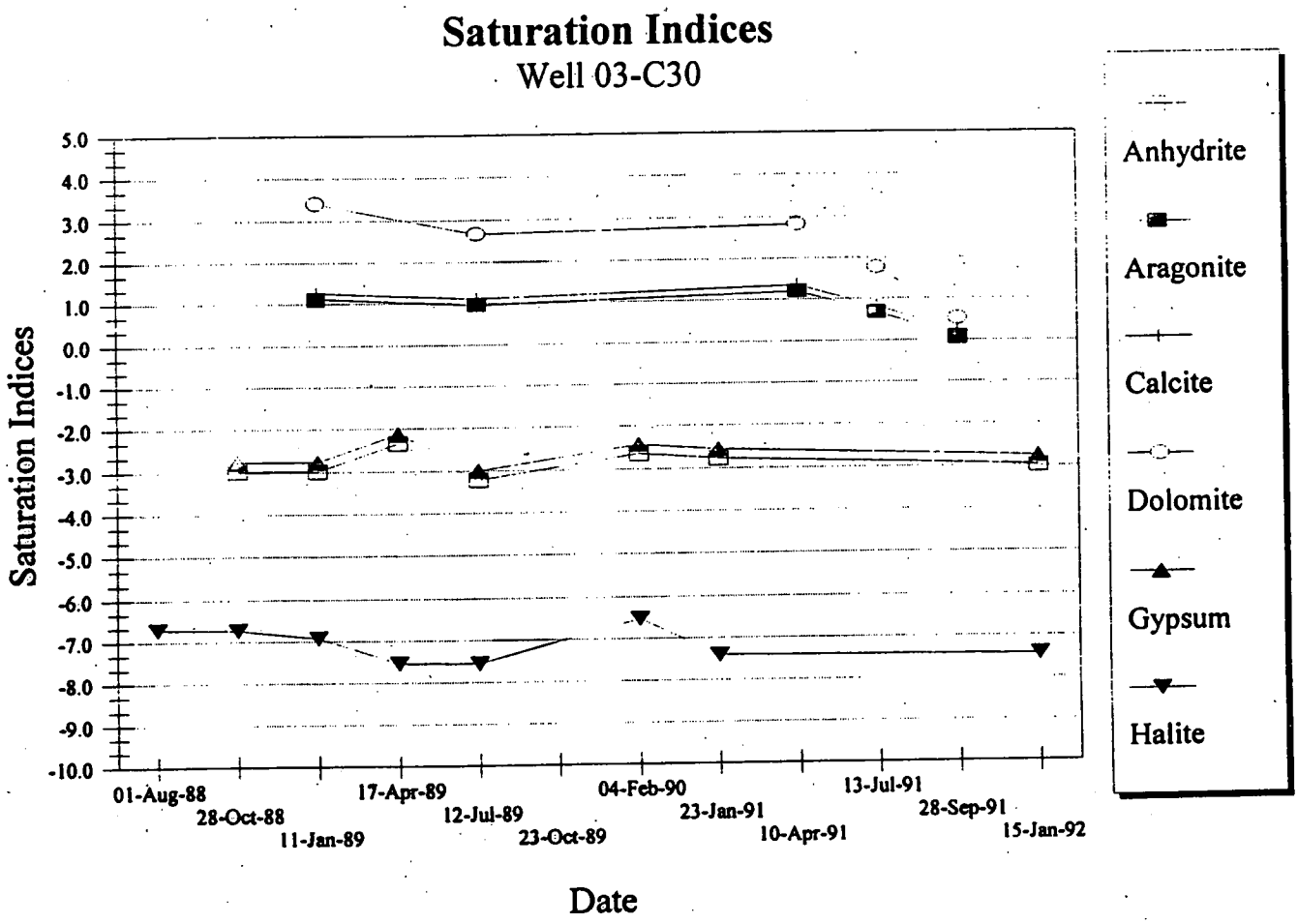
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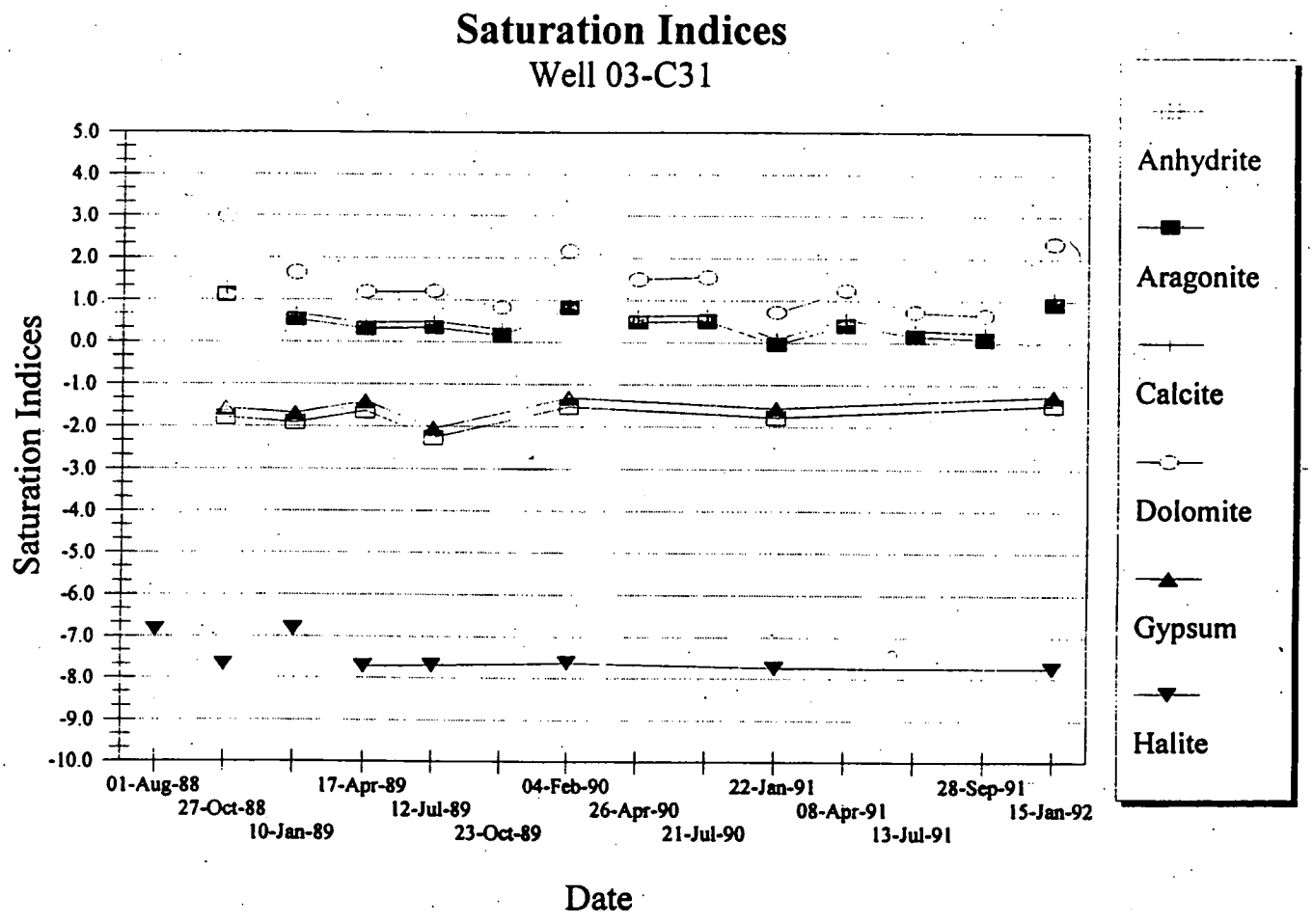
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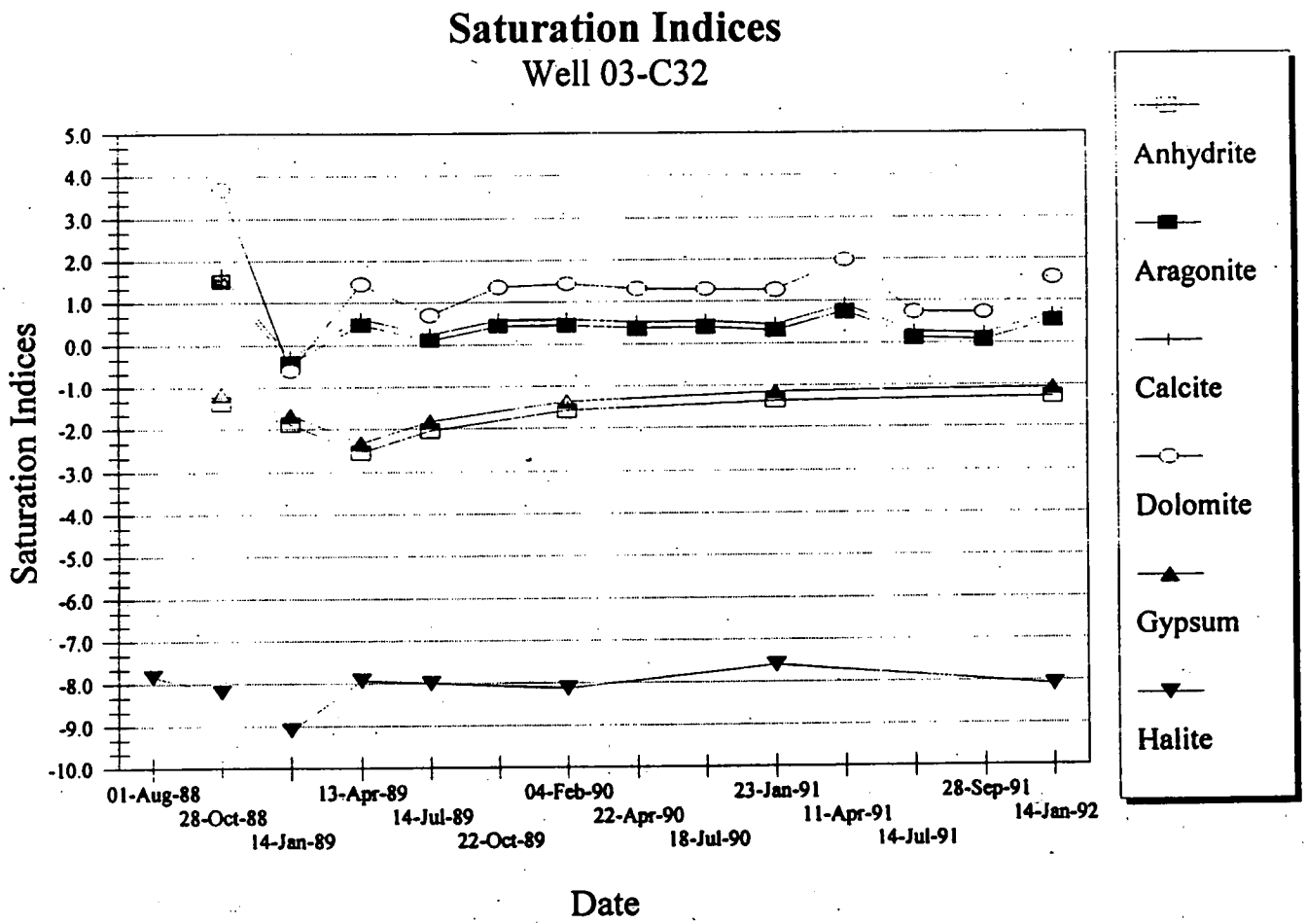
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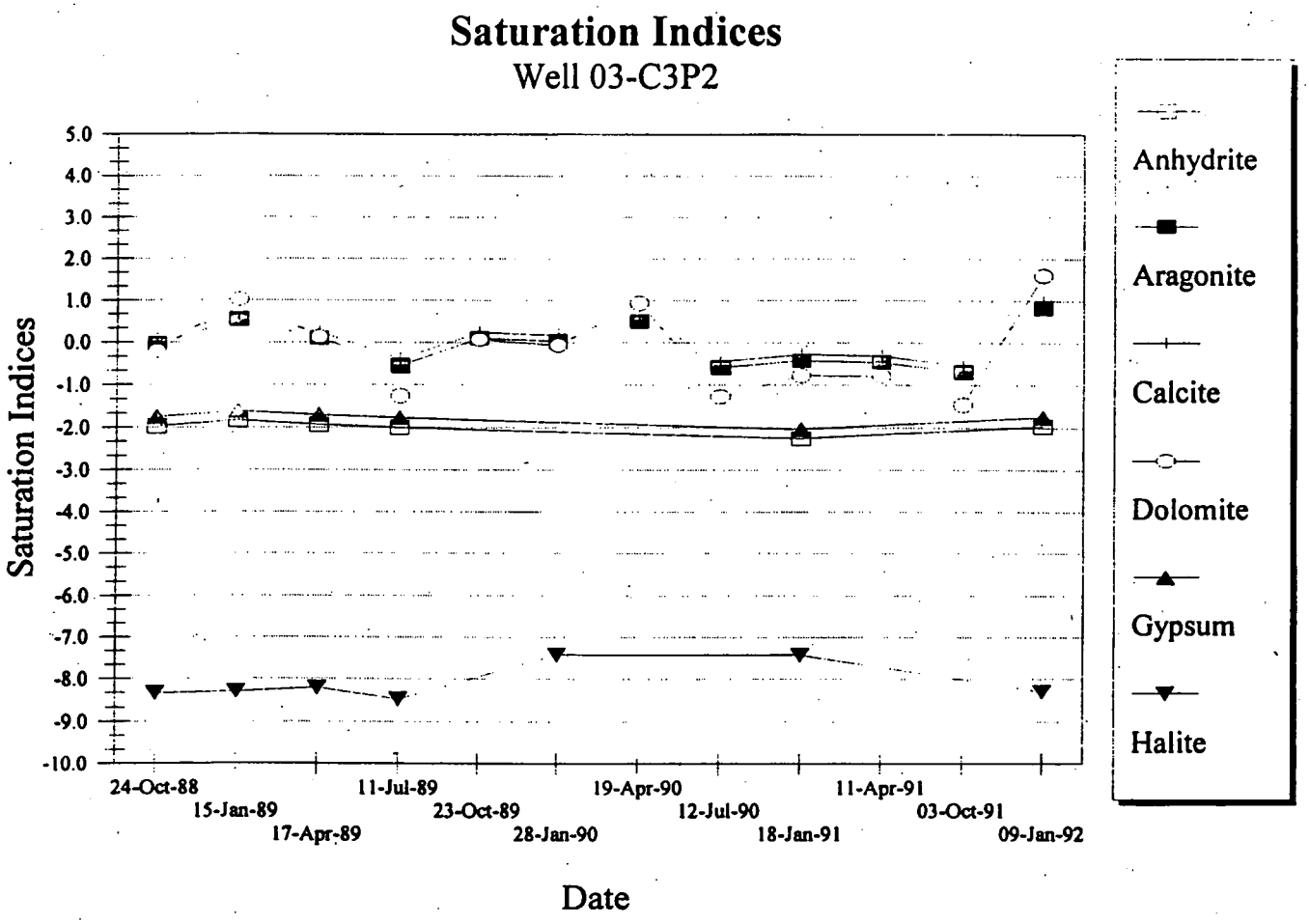
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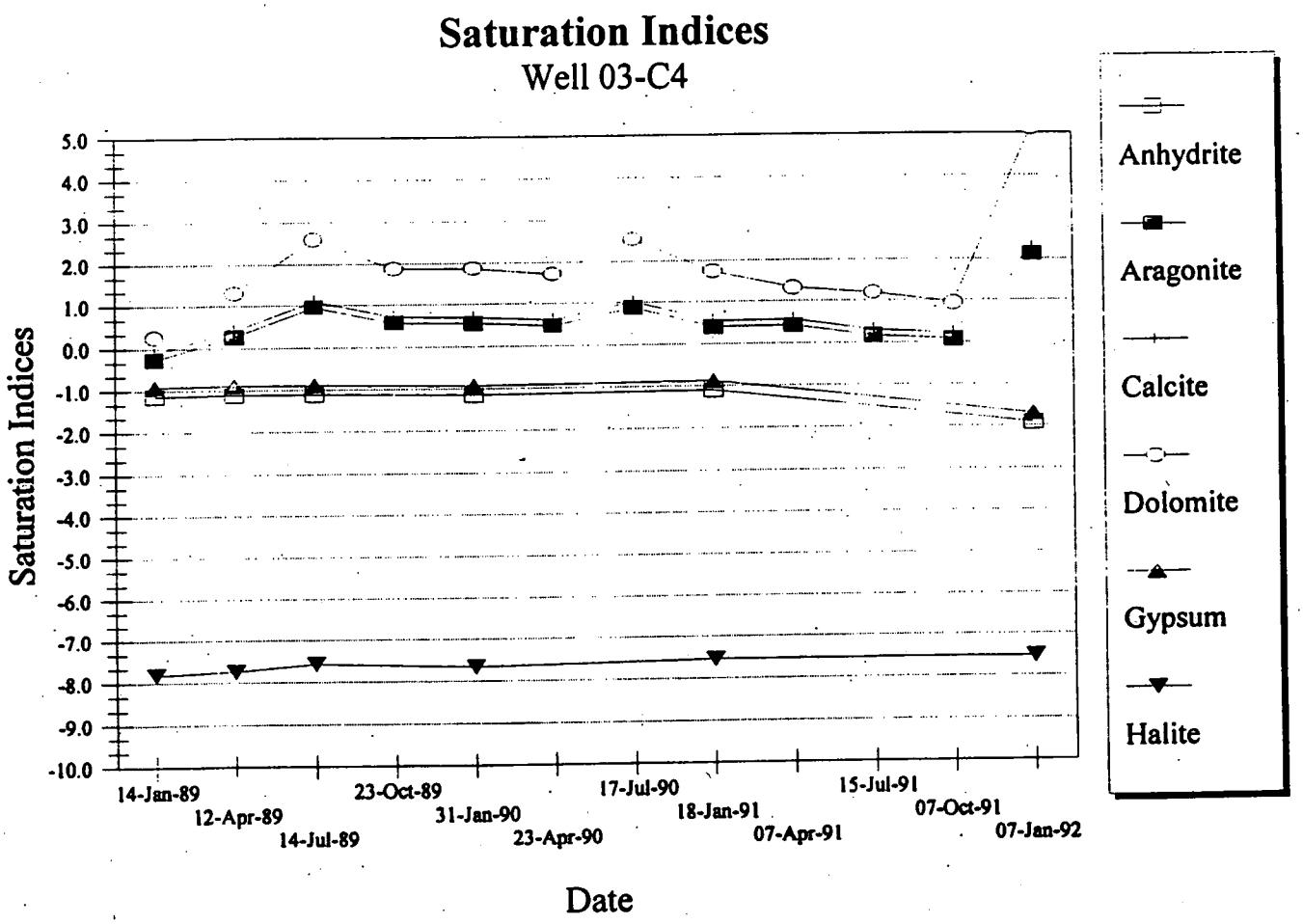
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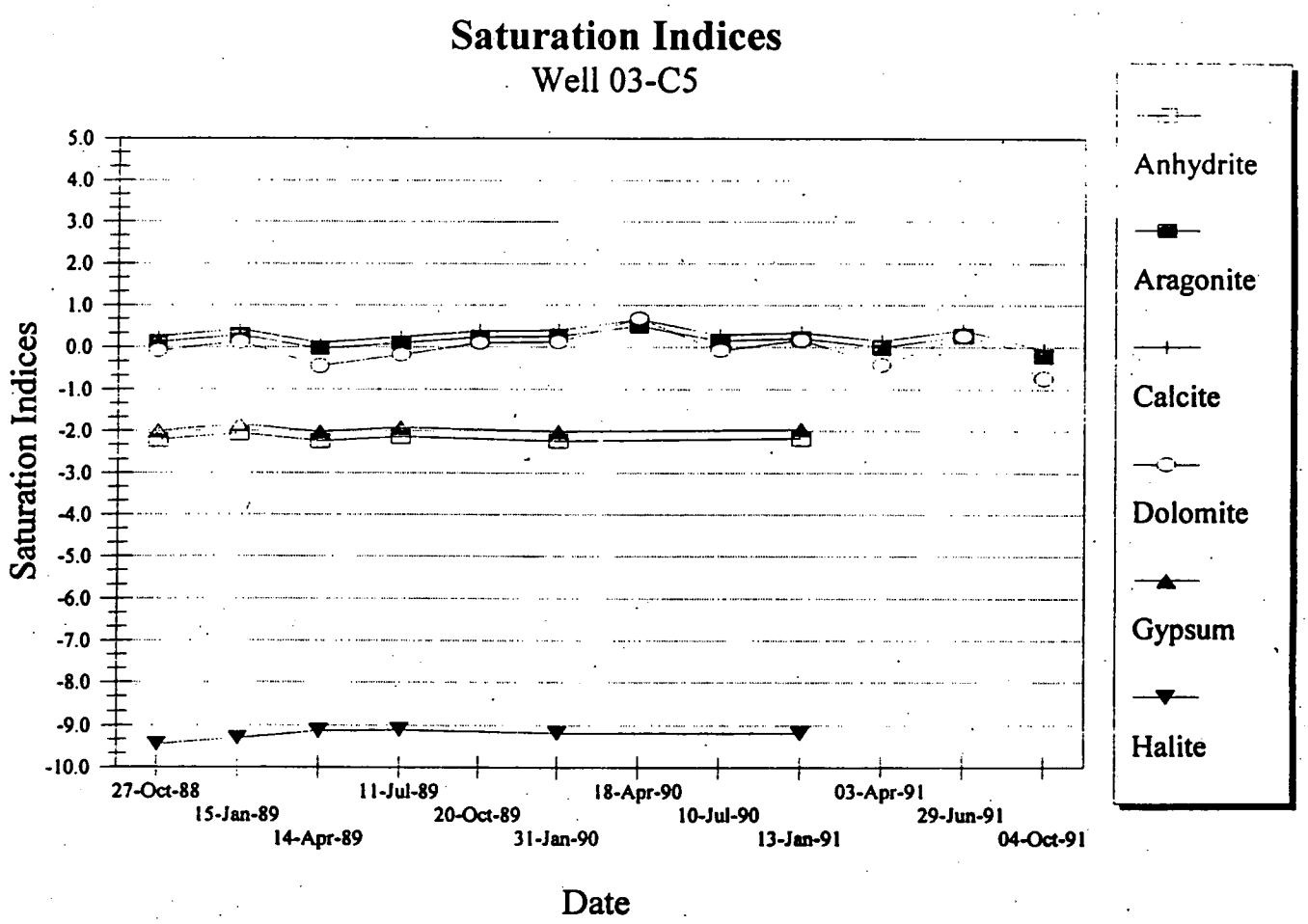
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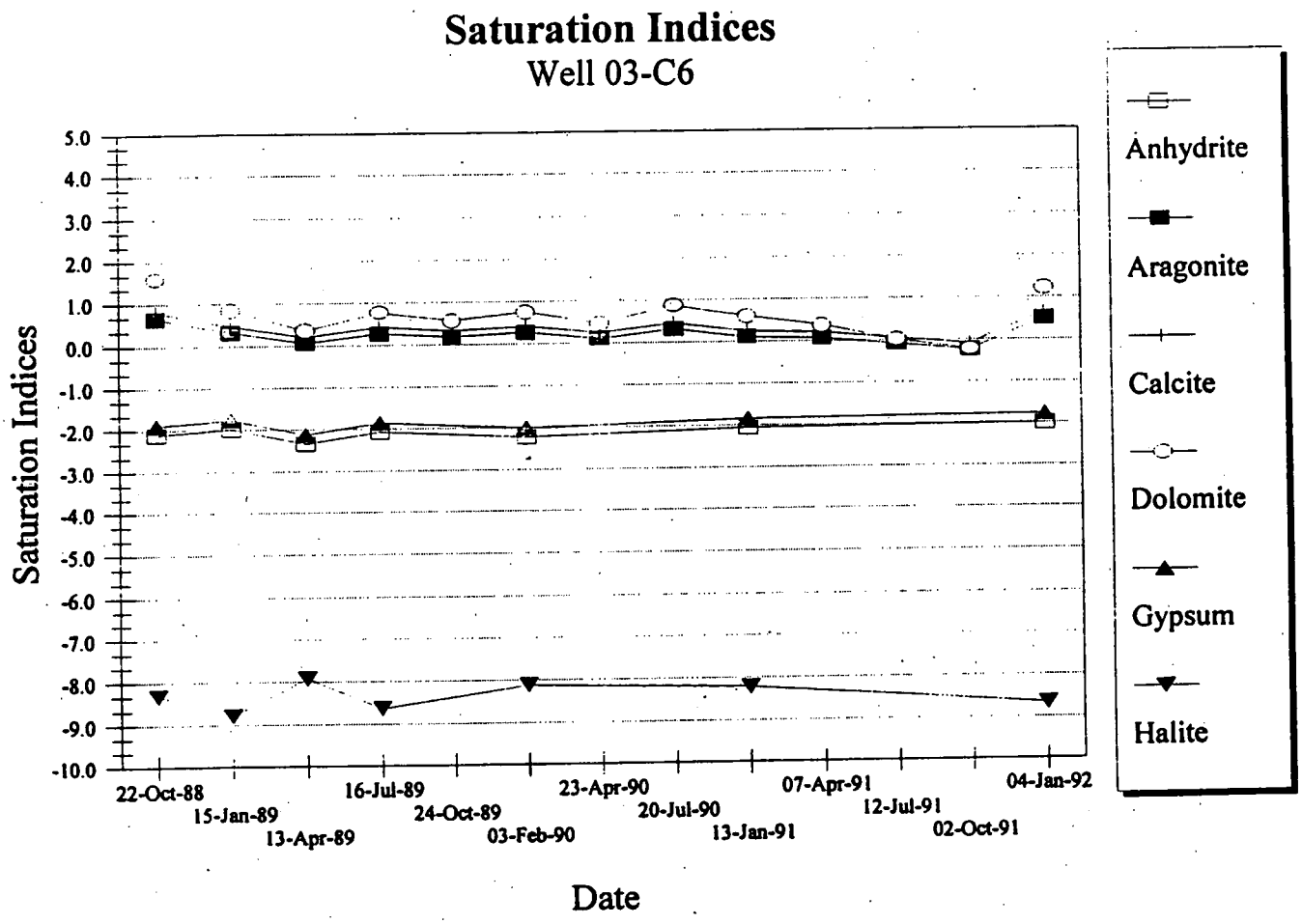
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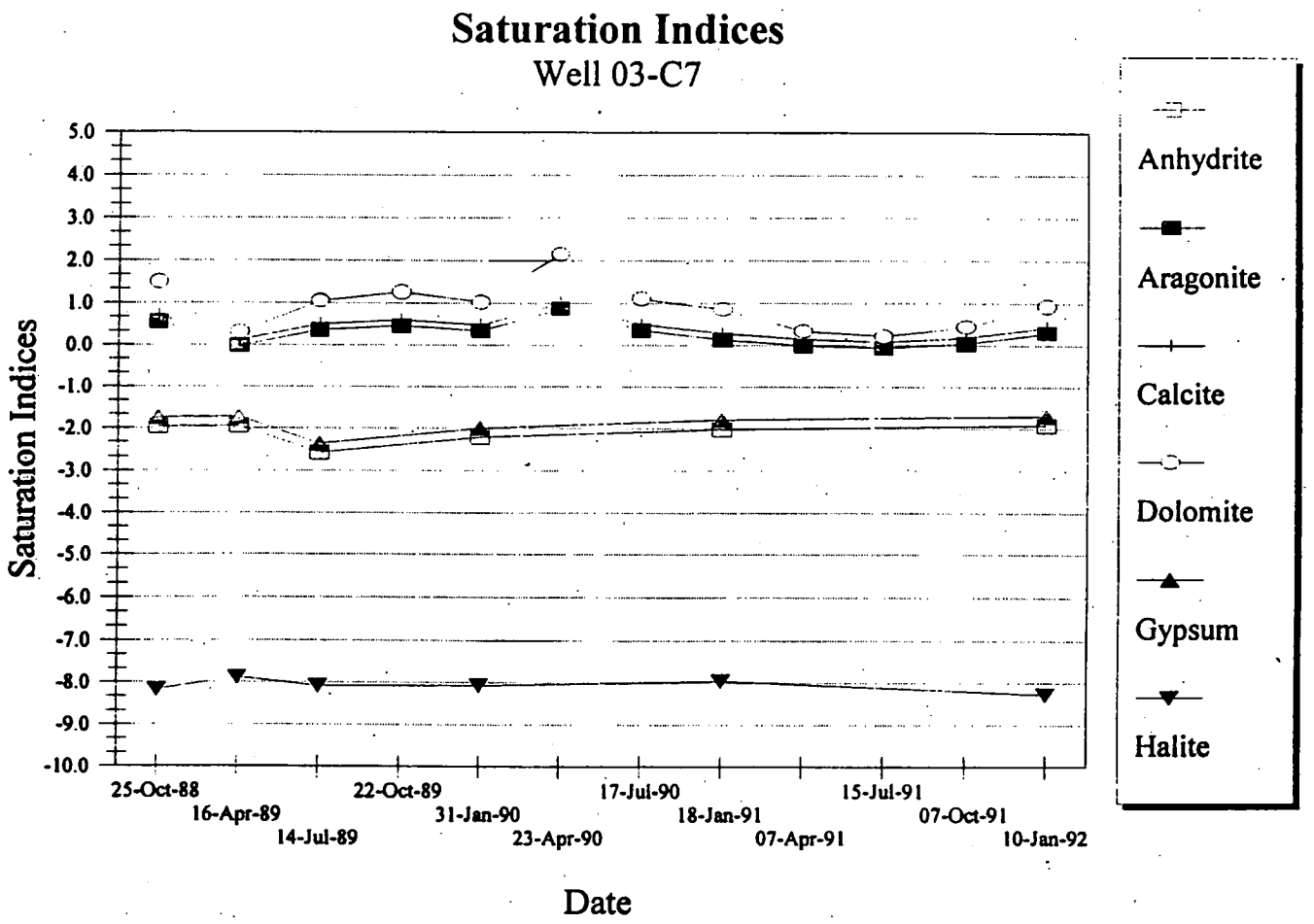
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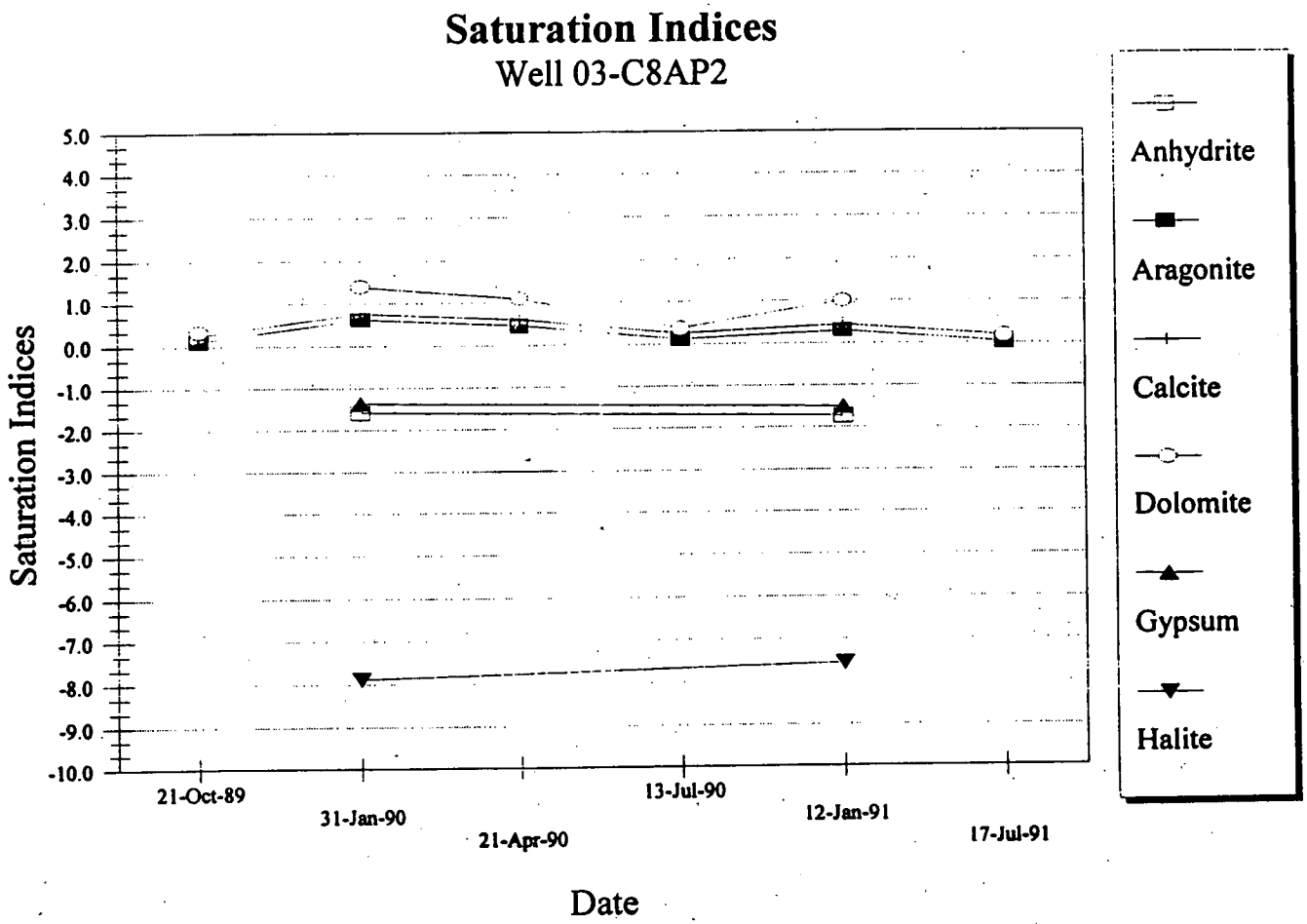
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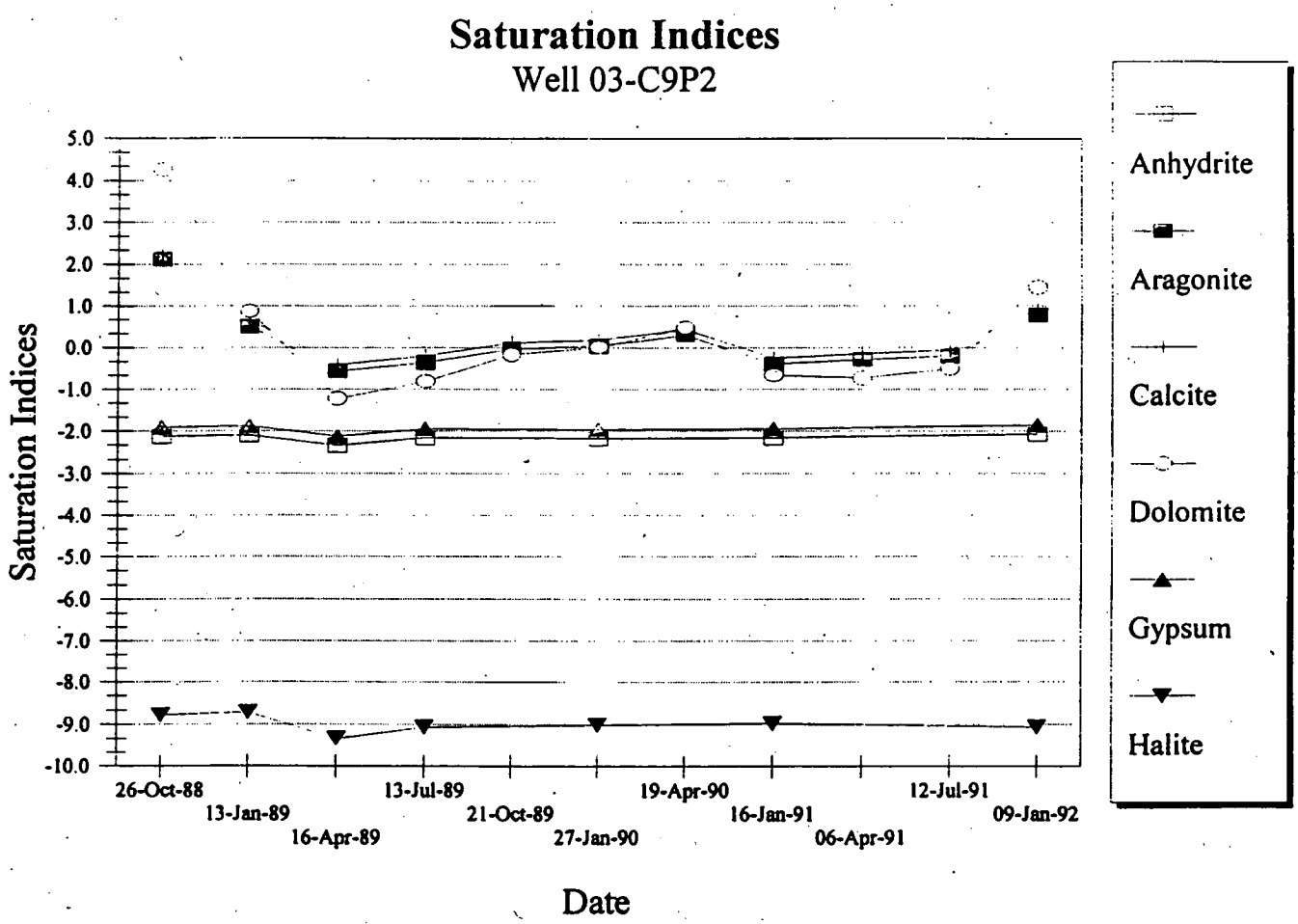
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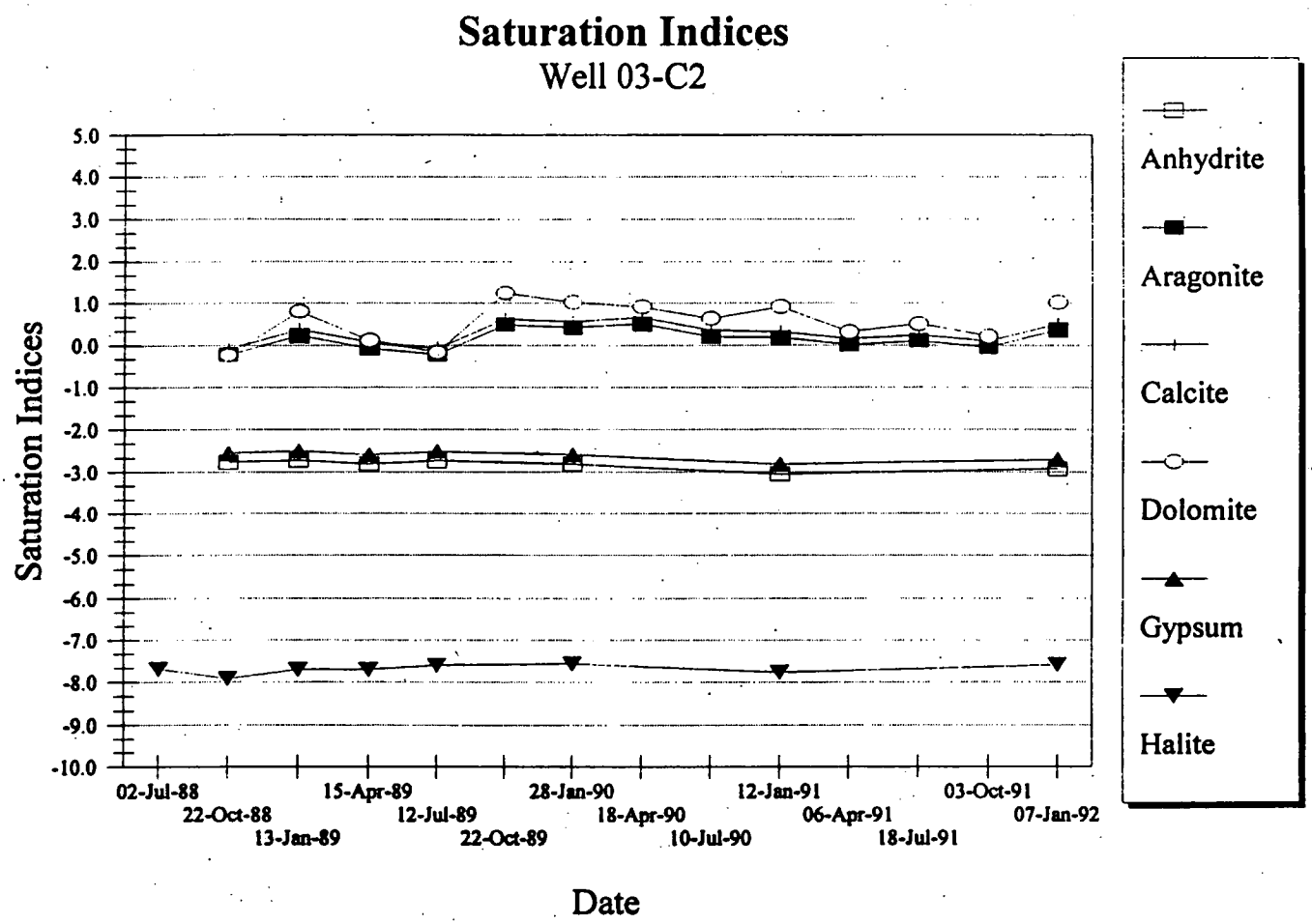
Appendix 2.4

Speciation Model Results for Wells Screen in the Beaver Bend Creek Aquifer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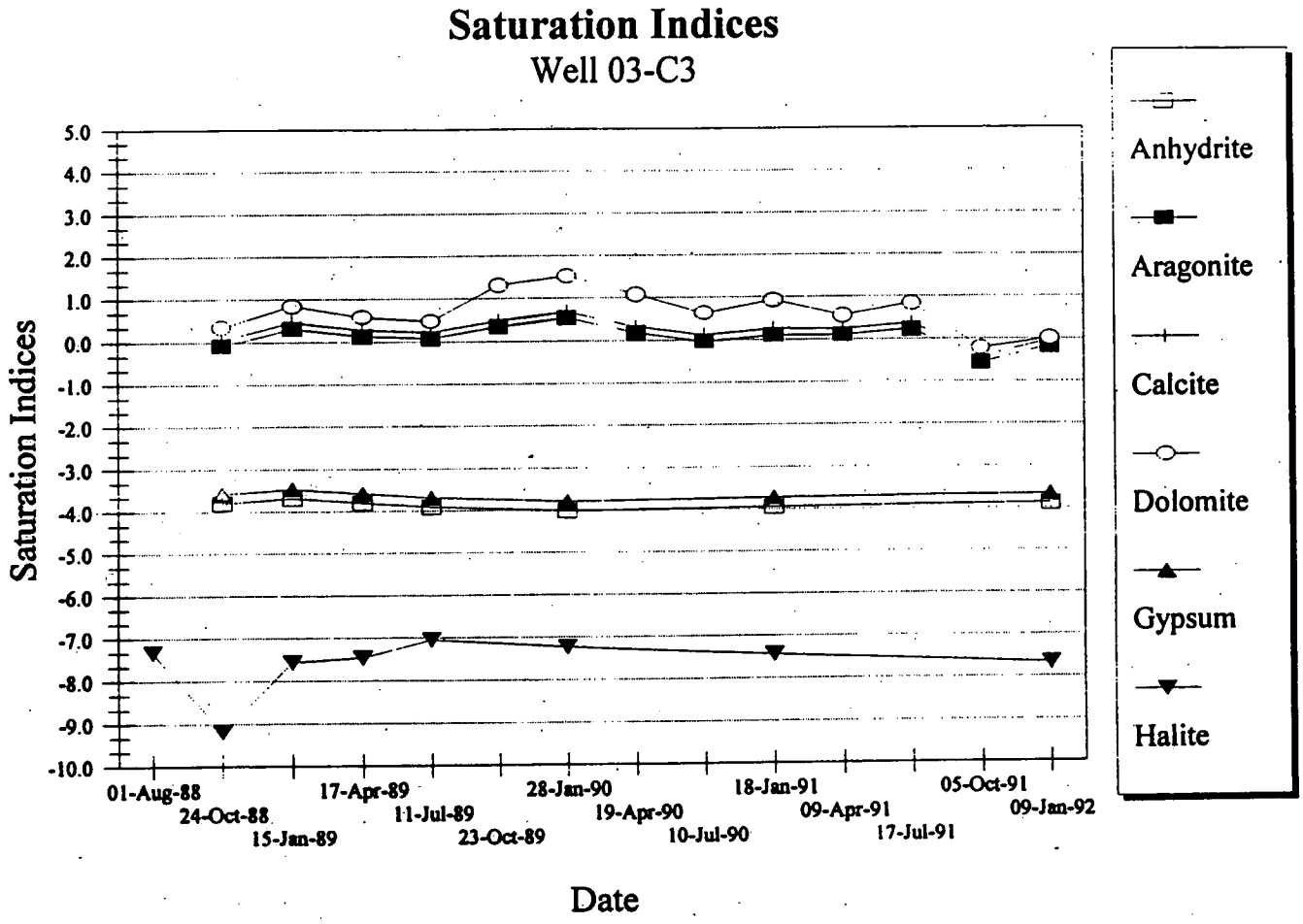
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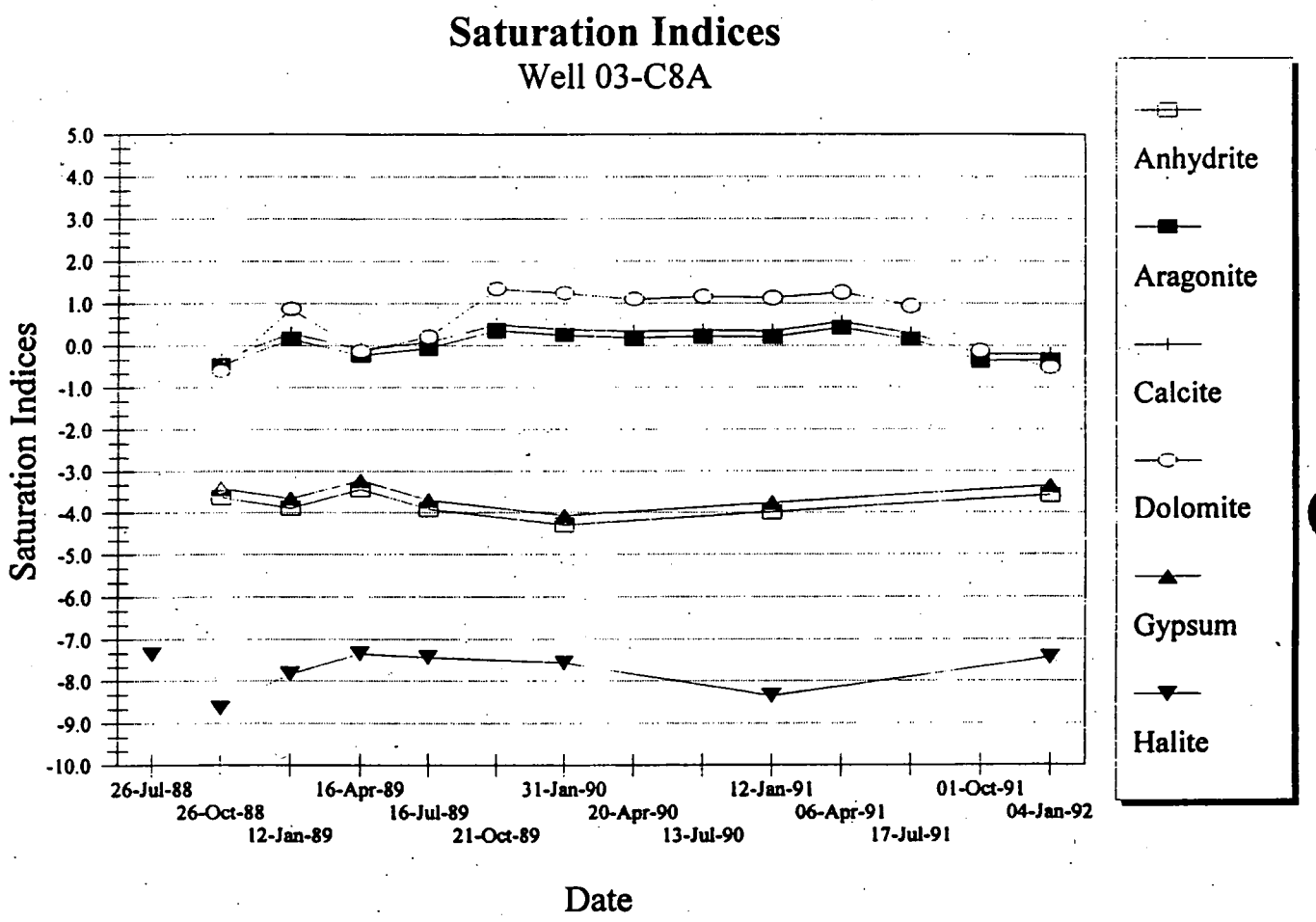
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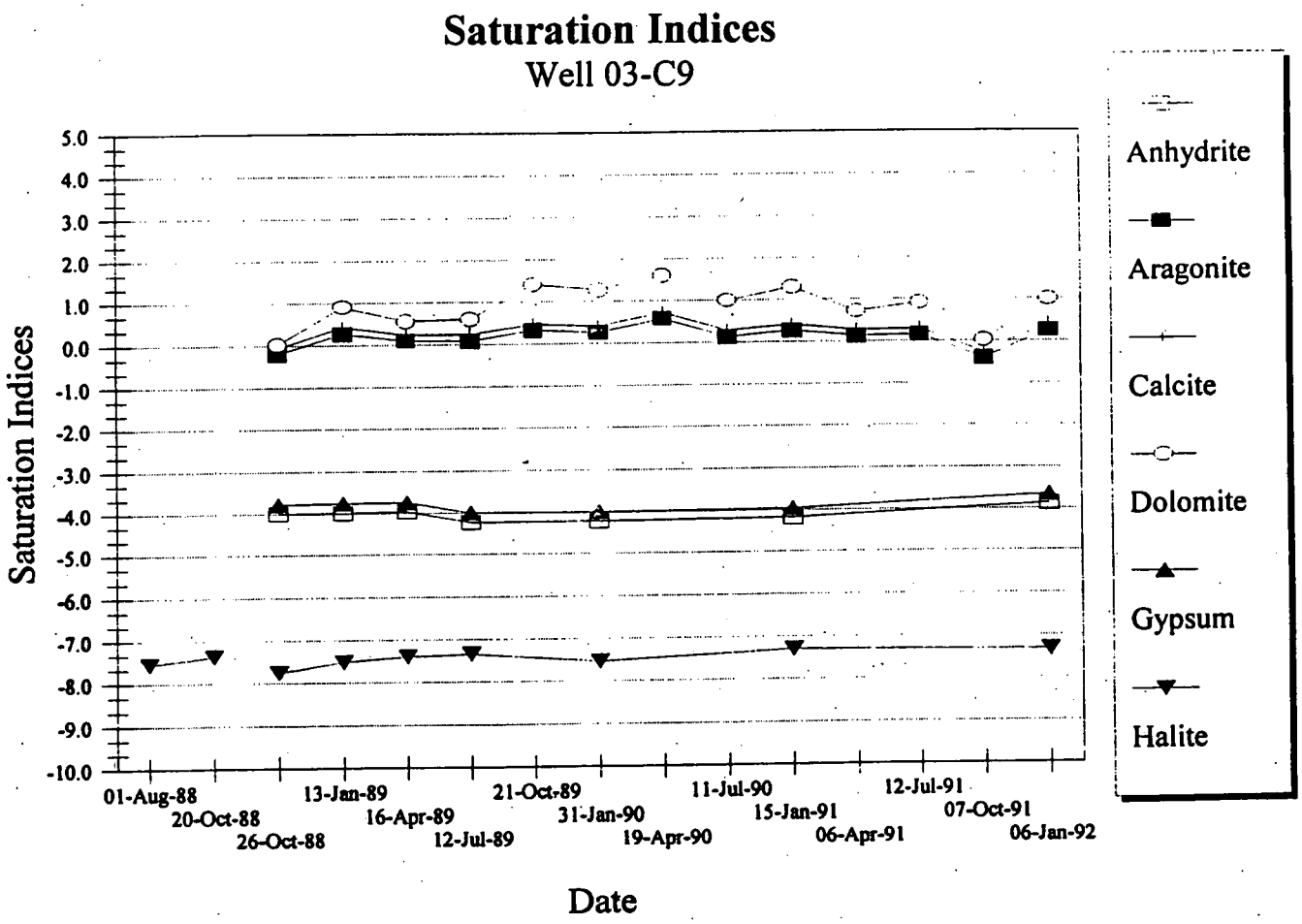
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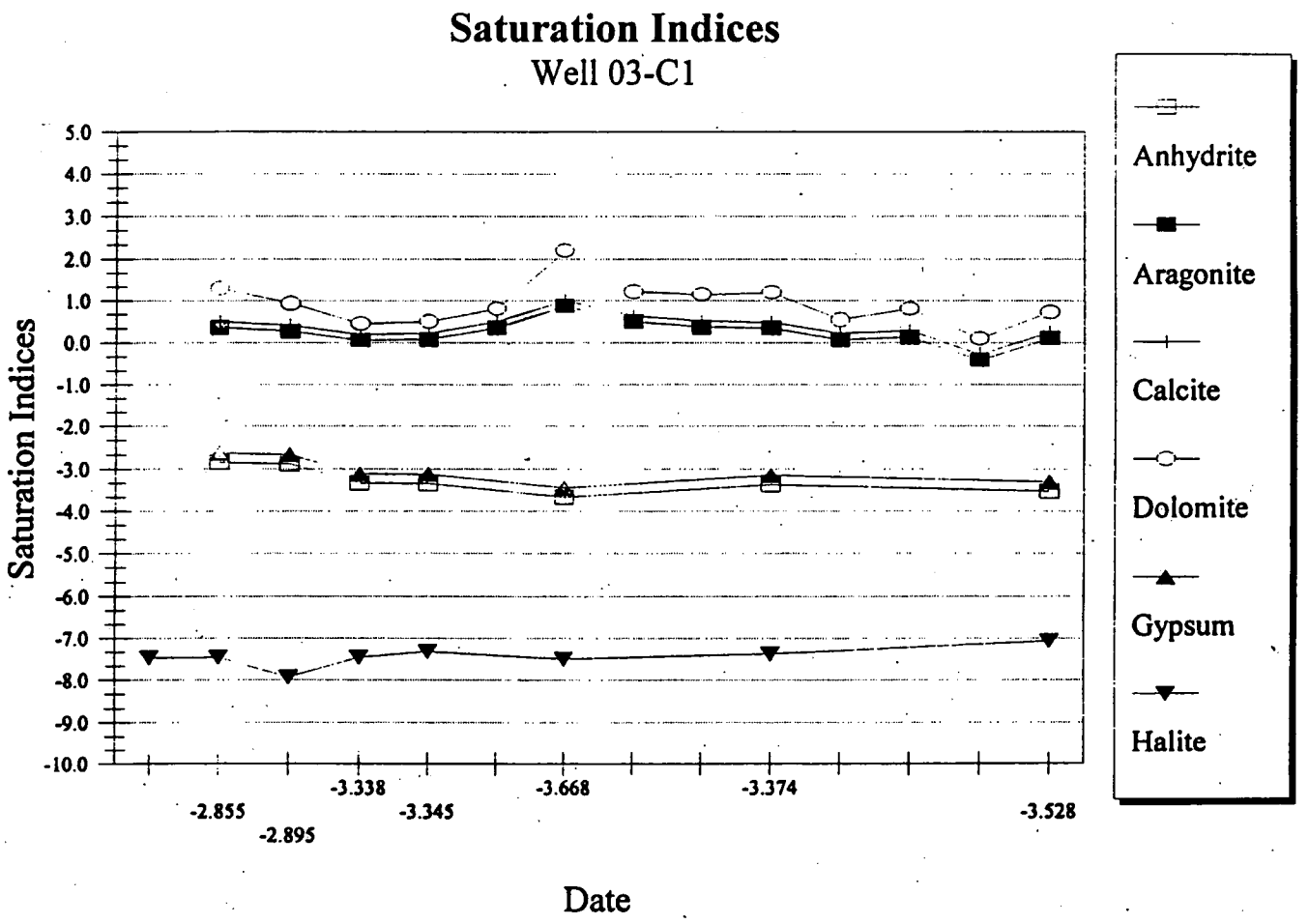
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CHAPTER 3

QUANTITATIVE TRACER TEST OF BIG BEECH CREEK AQUIFER AT THE AMMUNITION BURNING GROUNDS, NAVAL SURFACE WARFARE CENTER, CRANE, INDIANA

Abstract

Tracer experiments are often required to determine patterns of groundwater flow in karst terrains. Qualitative tracing techniques using dyes and passive detectors for tracer recovery can be used to establish approximate flow-routes and groundwater basin boundaries. However, to accurately establish water budgets and determine amounts of tracer recovered dictates a quantitative approach of measuring the concentration of tracer and volume of water emerging at a recovery point.

A quantitative tracer test of the karst system in the Beech Creek aquifer at the Crane Naval Surface Warfare Center, Indiana, has been conducted. 1.6 kilograms of Rhodamine WT (20%) and 18.3 kilograms of Br^- ionic tracer were injected into a water well situated on a karst conduit. Tracers were collected with both passive dye receptors and continuous water sampling at 14 spring orifices in the area.

Rhodamine and Br^- were detected at only one spring, consisting of a complex of 2 major orifices (Spring A and Spring A') and several diffuse seeps approximately 2000 meters from the injection well. The Br^- tracer breakthrough occurred at 7 hours, one-half hour before the Rhodamine dye. The Br^- pulse dissipated approximately 14 hours after being detected while Rhodamine dye was still detected days later. Approximately 80% of the injected Br^- was recovered at the 2 major spring orifices. 10-15% of additional Br^- is believed to have issued from the diffuse

seeps. Thus approximately 90-95% of the injected Br^- can be accounted for. Approximately 110% of the injected Rhodamine dye was recovered from the same springs. That practically all of the injected tracers were recovered from the Spring A complex indicates that the karst system that was injected into has only one outlet, which is located at the Spring A complex.

The early arrival and short lived Br^- tracer pulse, compared to Rhodamine, illustrates the more conservative nature of the ionic tracer. Only one spring complex appears to be directly linked to the karst system into which the dye was injected. Using the time of first arrival for the Br^- tracer, the effective conductivity for this system is 286 m hr^{-1}. The other springs do not appear to have hydrologic connection to this karst system.

Simultaneously, a tracer experiment was conducted in which 1.6 kg of Eoscene was injected into well 03-10. This well was also believed to be on a highly conductive, or potentially karstic, part aquifer. Eoscene was never detected from springs or wells during the test. This indicates that either 03-10 is not situated on a karst conduit or the karst system that it belongs to is not part of the system that was sampled.

These results indicate the complicated nature and unpredictable behavior of groundwater flow in karstic regions.

Introduction

As discussed in Chapters 1 and 2, the Beech Creek aquifer is karstic in nature. A typical feature of karst flow systems is that water entering the system, although it may be stored for a period of time, usually exists the system via karst outlets. The ABG, and the surrounding area, has

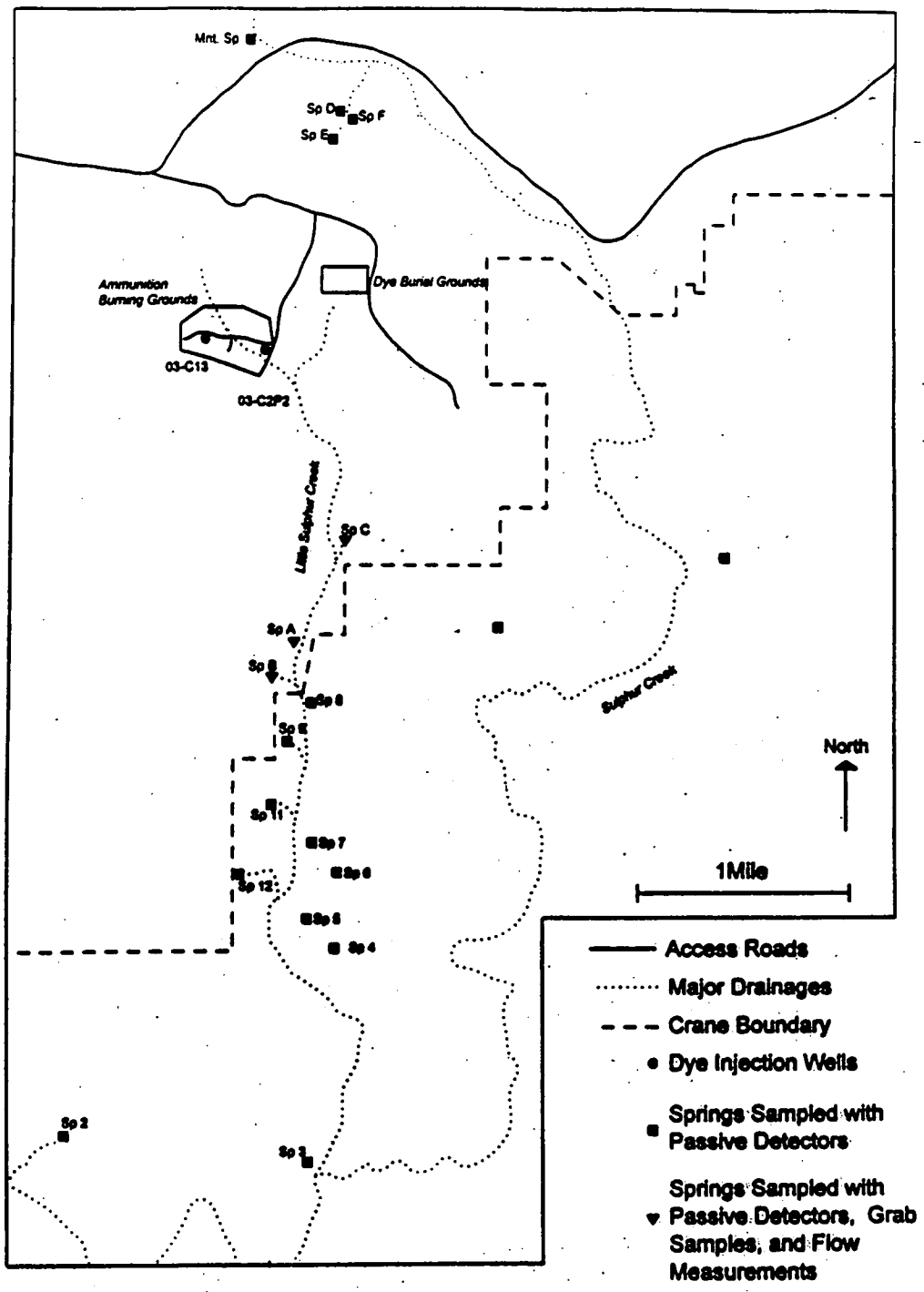


Figure 3.1. Study area, location of injection wells and location of springs used for monitoring during the tracer test.

numerous potential karst outlets in the form of springs. Figure 3.1 shows the location of springs that have been identified as issuing from the Beech Creek aquifer and therefore may be hydrologically connected to the karst system. Predicting the pattern of groundwater flow in the Beech Creek aquifer is difficult since flow can occur across typical flow boundaries defined by the porous media (ie. groundwater divides), the direction of flow can change temporally. Because of the unique hydrologic characteristics of karst terrains, tracer tests are generally the most practical and satisfactory method to provide information about the movement of water in karst aquifer system.

Tracing groundwater flow is accomplished by adding a distinctive substance, or tracer, to groundwater and monitoring down-gradient locations of concern. Dumping of such distinctive substances, either intentionally or accidentally, has often served to identify point to point connections between input points and resurgences such as springs or pumped wells. If establishing a hydrologic connection between a specific inflow point and a discharge point is all that is desired from the experiment, then simply dumping the tracer and looking for it downstream is all that is needed. This techniques defines a qualitative tracer test. Qualitative tracing techniques use tracers (commonly organic dyes) and passive detectors for tracer recovery to establish approximate flow-routes and groundwater basin boundaries.

To accurately establish water budgets, traveltimes and flow velocities of the tracer, and / or the amounts of tracer recovered, a quantitative approach of measuring the concentration of tracer and volume of water emerging at a recovery point needs to used. This technique defines a quantitative tracer test. Quantitative tracing techniques commonly use tracers (either organic dyes

or ionic solutions), automatic samplers taking samples at known time intervals, and continuously recorded discharge measurements to establish parameters of the tracer results.

Both qualitative and quantitative tracing techniques were used in this study at the ABG.

Previous Studies

Hydraulic connection between the Beech Creek aquifer and Springs A and A' was established by a previous qualitative dye trace at the ABG (Murphy and Ciocco, 1990). During low flow conditions in the karst system, one pound of fluorescein dye was injected into well 03-C02P2 at the ABG. The presence of dye was visually detected under ultraviolet light between 5 and 24 hours at Springs A and A' from passive detectors placed at the spring orifices (see Figure 3.1 for the location of the injection well and springs). Dye continued to be observed in a "relatively high" concentration for at least 5 days.

Springs B and C, also in the Little Sulphur Creek valley, were monitored but showed negative or "weakly positive" indication of tracer. Although dye was not positively identified from Springs B and C, it was hypothesized that these springs are groundwater outlets at high flow conditions. Four springs north of the ABG (Springs E, F, G, and Mountain Spring) were also monitored and showed a "weakly positive" indication for tracer in "normal light". It is, however, possible that the green coloration of the solution was caused by algae (Murphy and Ciocco, 1990). This test did not monitor off-base springs. Based upon qualitative judgement, it is believed that little of the injected dye was recovered during this tracer test (Murphy and Ciocco, 1990).

We have used the results of previous dye trace to design a quantitative dye trace for this study.

Methods

It is obvious that the methods used in the previous dye trace cannot definitively determine whether any spring, except for Springs A and A', are hydrologically connect to the karst system that was traced. Additionally, since flow measurements were not taken for water emerging from Springs A and A' it is not possible to quantify the amount of tracer recovered. Unknown tracer recovery is problematic in this situation since it is desirable that the results be able direct remediation strategies for contaminates in a fracture system. Low tracer recovery indicates either that significant amounts of tracer are being stored in the fracture system or that the tracer is leaving the system at unknown locations. Either scenario would require that the remediation strategy be modified.

In hopes of improving upon the previous qualitative trace, a tracer test was proposed in which two objectives were sought: 1) to quantify the amount of tracer recovered from the major spring on NSWC property, and 2) to determine if any springs located on property immediately off of NSWC property receive any tracer.

In order achieve to quantify the amount of tracer recovered, weirs were built for Springs A', B, and C, and a flume was built for Spring A so that flow measurements could be made. Continuous recorders were installed at each spring so that flow could be recorded remotely at very frequent intervals. Each wier and flume were calibrated for the range of expected flow. The

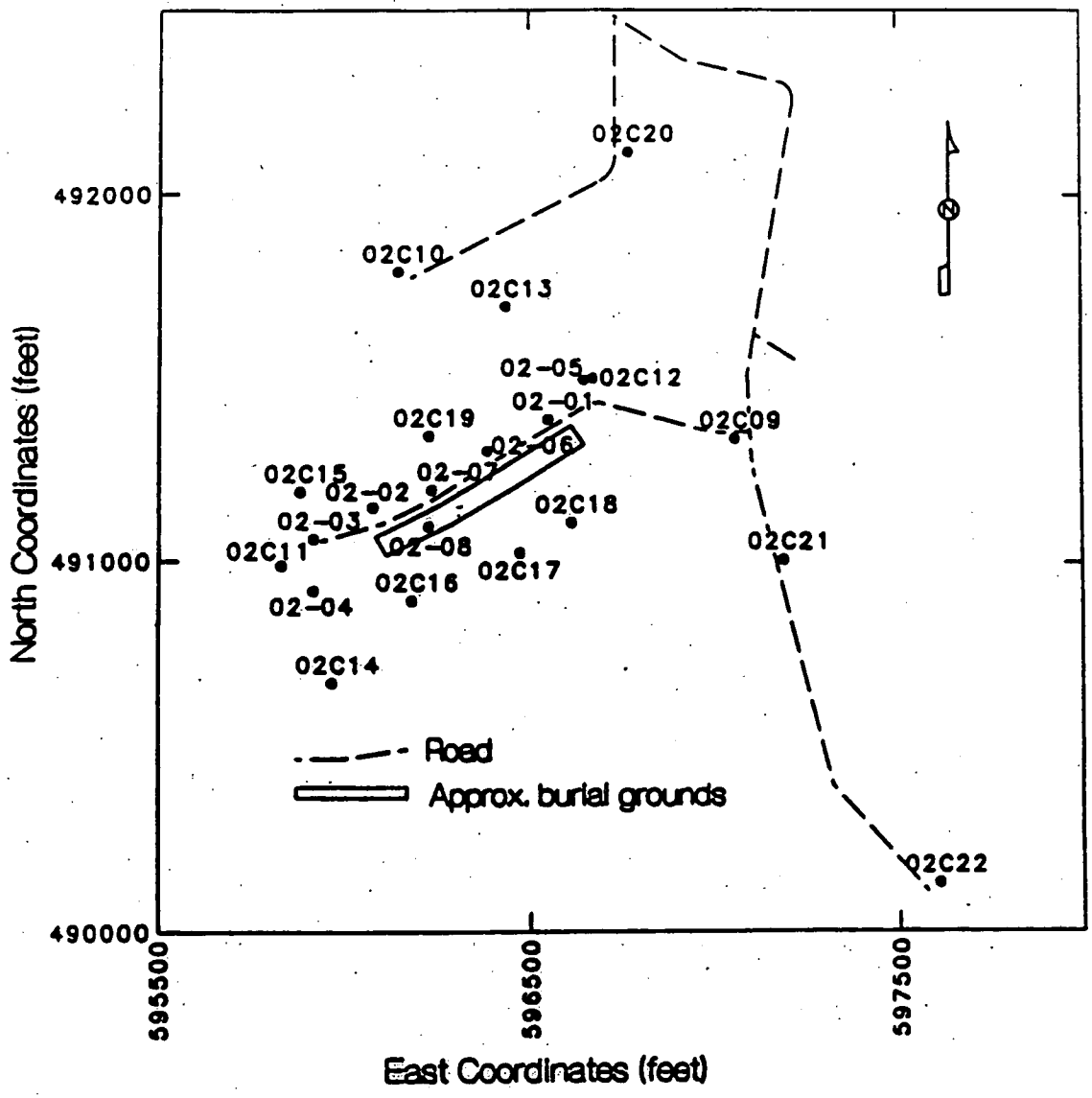


Figure 3.2. Location of wells in the Dye Burial Grounds.

calibrations were checked frequently during the tracer test and adjusted appropriately when needed.

In order to determine the amount of tracer to inject in the karst system ambient tracer concentrations needed to be established for the Beech Creek aquifer. Previous dye tracing in the ABG and activities adjacent to the Little Sulphur Creek drainage basin may produce ambient fluorescence in groundwater samples. Therefore a detailed analysis of background fluorescence was conducted to verify which tracers, and in what concentrations, could be used during the test.

The Dye Burial Ground (DBG) is located approximately one half mile to the northeast of the ABG, and is potentially in hydrologic connection with the ABG (Figure 3.1). The DBG may, therefore, be a potential source of fluorescent material to groundwater in the study area. Samples were collected for background dye analysis from the DBG wells from 4/17/96 to 5/1/96. Grab samples were taken from 27 wells and one seep. Figure 3.2 shows the location of all wells in the DBG. Samples were collected using a bailer constructed from a 3 foot length of ¾ inch diameter PVC tubing. The bottom was capped with a ¼ inch diameter opening to allow water to enter the bailer and was sealed with a rubber washer and stainless steel ball bearing to contain the water sample as the bailer was removed from the well. The bailer was lowered into and retrieved from the wells using a 1/8 inch diameter nylon rope that was secured to the top of the bailer. Samples were transferred from the bailer into 4 ounce amber glass bottles for transportation to the lab. All samples were analyzed within 24 hours of returning to the lab.

Passive charcoal detectors were placed in 37 wells for two six-day intervals. The detectors consisted of approximately 25 milliters of activated charcoal contained in a plastic mesh. The detectors were fastened to nylon ropes and steel sinkers, and were lowered approximately 3 feet

below the water levels in the wells. At the end of the 6 day interval, the detectors were retrieved and placed into separate, sealed plastic bags and transported to the lab.

All samples were analyzed for fluorescence using a Shimadzu RF-5000U Spectrofluorophotometer. Grab samples were directly analyzed whereas the charcoal packets (ie. passive detectors) were emptied into screw top plastic containers and eluant was added until the charcoal was completely submerged. The eluant solution is a mixture of fifty percent isopropyl alcohol, 30 percent deionized water, and 20 percent ammonium hydroxide. The samples were allowed to stand for 12 hours prior to analysis.

Approximately 3 milliliters of each sample were transferred into a disposable rectangular polystyrene cuvette that was placed in the RF-5000U for analysis. Dye concentration, based on the magnitude of the fluorescence peaks, have been calculated from calibration curves and are reported in parts per billion.

The results of the background dye analyses from the DBG are presented in tabular form in Appendix 3.1. The table includes concentration of Fluorescein, Eosine, and Rhodamine WT. Only fluorescein was detected in trace amounts (<1 ppb) in the passive charcoal detectors. The maximum concentration of fluorescein dye (4 ppb) was found in the seep. Based on these results, fluorescein was not used in the proposed quantitative dye trace.

For two weeks prior to the quantitative tracer test, grab samples and passive detector samples consisting of activated charcoal , so called "bugs" (Figure 3.3), were collected from all springs to evaluate determine which organic dyes and ionic tracers could be successfully used

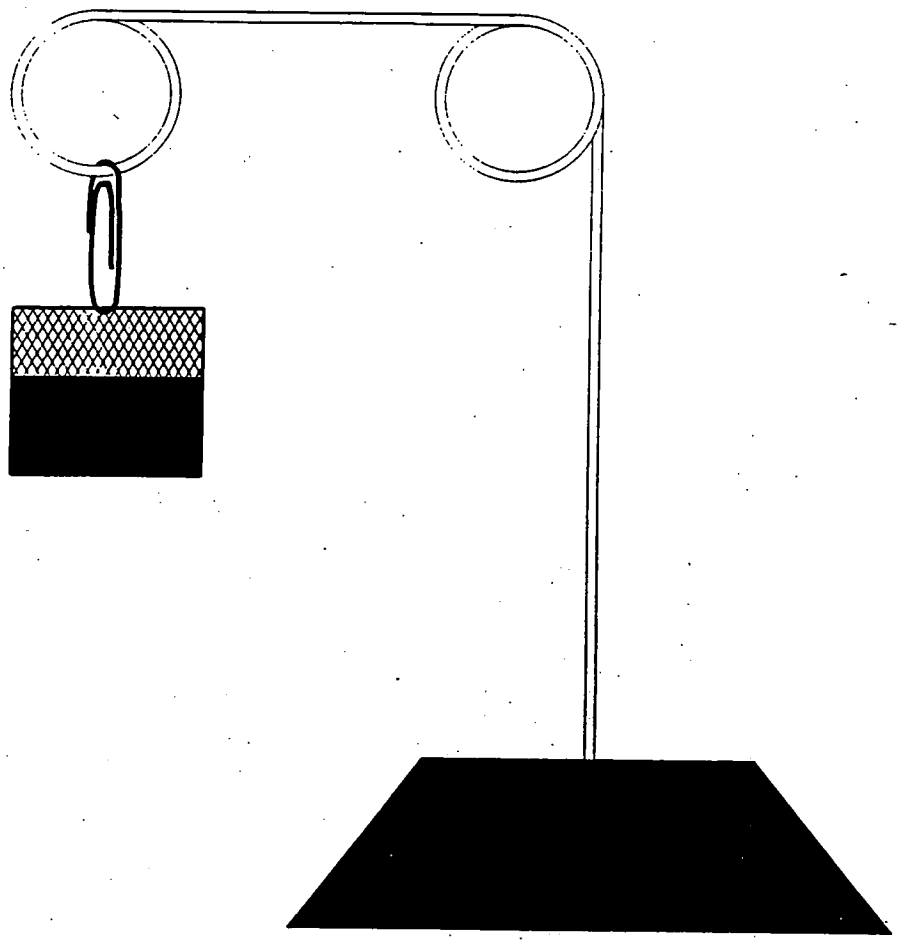


Figure 3.3. "Bug" used to suspend dye detectors in springs.

during the test. Each passive dye detector was placed in the center of flow from the spring to maximize exposure to the dye. The dye recovery packets were left in place from 1 to 7 days. The background analysis showed no indication of organic dye issuing from any of the springs that were sampled. Additionally, chemical analysis of the water issuing from the springs showed that Br^- was below the detection limit of the lab equipment. Based on these results, it was determined that Rhodamine WT (20%) and Eocene would be used as dye tracers and Br^- would be used as an ionic tracer for the quantitative dye trace.

The amount of Rhodamine WT and Eocene to be injected determined by a rule of thumb calculation established by Quilin (1986) where 1 pound of dye is used per mile of desired trace

length. This approximate distance from well 03-C02P2 to spring 2 (Figure 3.1) is 3.5 miles. Therefore it was determined that 3.5 pounds of Rhodamine (1.6 kilograms) and 3.5 pounds of Eocene (1.6 kilograms) were injected. The quantity of Br^- injected was determined by consultation with researchers at the Westinghouse Project in Bloomington, IN (Mike McCann). It was determined through comparison of discharge conditions at the springs in the study are to other tracer projects using Br^- as a tracer that approximately 18 kilograms of Br would be sufficient to trace the springs on NSWC property. 23.5 kilograms of Reagent Grade NaBr (solid) was obtained to dissolve in 151 liters of water. This amount of NaBr dissociates into 18.3 kilograms of Br^- ion.

Results

Well 03-C02P2 was injected with 1.6 kilograms of Rhodamine WT (20%) at 1232 hours (military time) on 5-3-97. This was immediately flushed with 151 liter solution containing 18.3 kilograms of Br^- ion. This was flushed with an additional 19 liters of distilled water. The injection of tracers was completed at 1259 hours.

Well 03-C10 was injected with 1.6 kilogram of Eocene at 1304 hours on 5-3-97. This was immediately 76 liters of distilled water. The injection of dye was finished by 1309 hours.

The karst system was at a high flow stage during the tracer test as 2.5 inches of rain fell the day before the test (5-2-97). Dye was not injected into either well until measurable discharge at each spring was within the calibrated range of the weirs and flume.

Automatic samplers at Springs A, B, C, and D were set to sample at 30 minute intervals until dye was observed visually discharging from the spring(s). Discharge measurements were

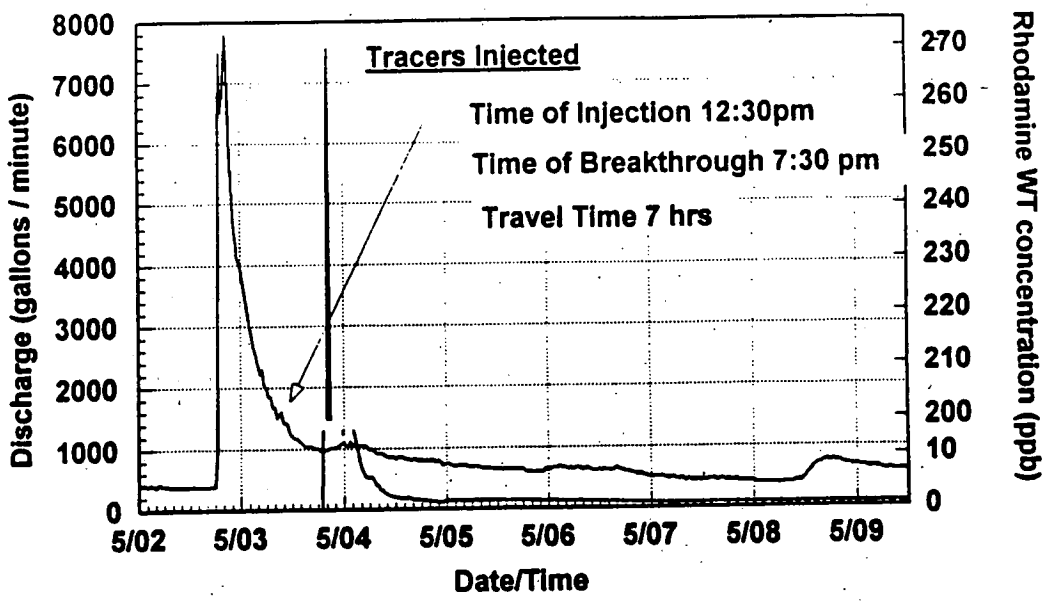
taken at Springs A, A', B, and C at 30 minute intervals. All samples were transferred to amber glass bottles (glass sample bottles were used since Rhodamine dye has a strong affinity for plastic which would result in dye loss), refrigerated, and returned to the Hydrogeology Lab at Indiana University. At IU, the samples were refrigerated until they were analyzed. All analysis were completed within a week from the date of sampling. The results of the analyses are present in Appendix 3.1.

Dye was visually detected at Spring A and Spring A' at 2000 hours on 5-3-97. A hand sample was taken at 2015. The automatic samplers were reprogrammed to sample thereon every 15 minutes until 0000 hours on 5-4-97, at which time the sampling interval was changed to every 30 minutes.

Rhodamine WT dye was not detected in grab samples or passive detectors, "bugs", from any of the springs except Springs A and A'. Eocene dye was never detected in grab samples or passive detectors.

Discussion

When the discharge, Rhodamine WT and Br^- are plotted against time, a breakthrough curve is produced. Breakthrough curves for Spring A and Spring A' sampling sites are shown in Figures 3.4 and 3.5 respectively. By analyzing the breakthrough curves, traveltime of the tracer can be calculated. For Spring A the breakthrough (first detection) of Rhodamine and Br^- occurred simultaneously at 1930 (5-3-97) hours, approximately 7.5 hours after injection. For Spring A', the breakthrough for Br^- occurred at 1900 hours, 0.5 hours before the Rhodamine WT breakthrough that occurred at 1930 hours. The Br^- tracer dissipated after about 14 hours while the Rhodamine



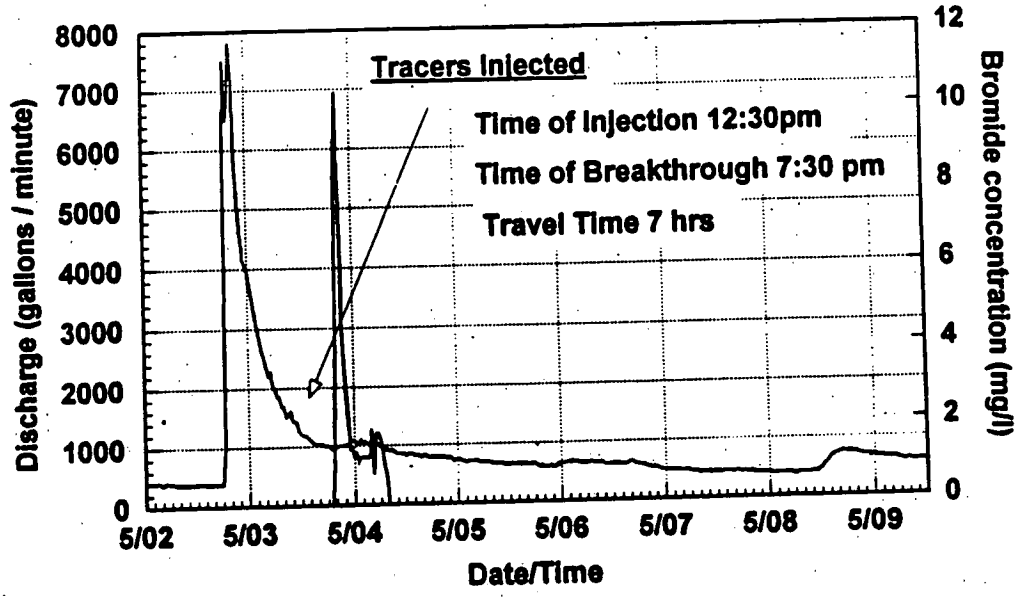
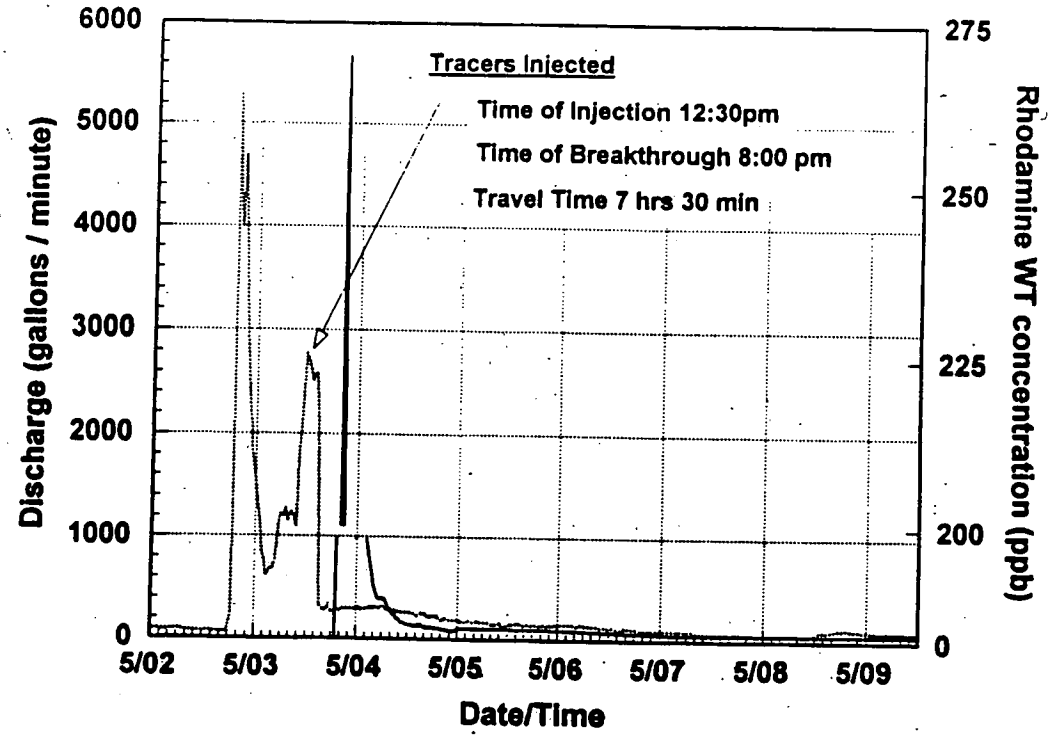


Figure 3.4. Breakthrough curves for Spring A.



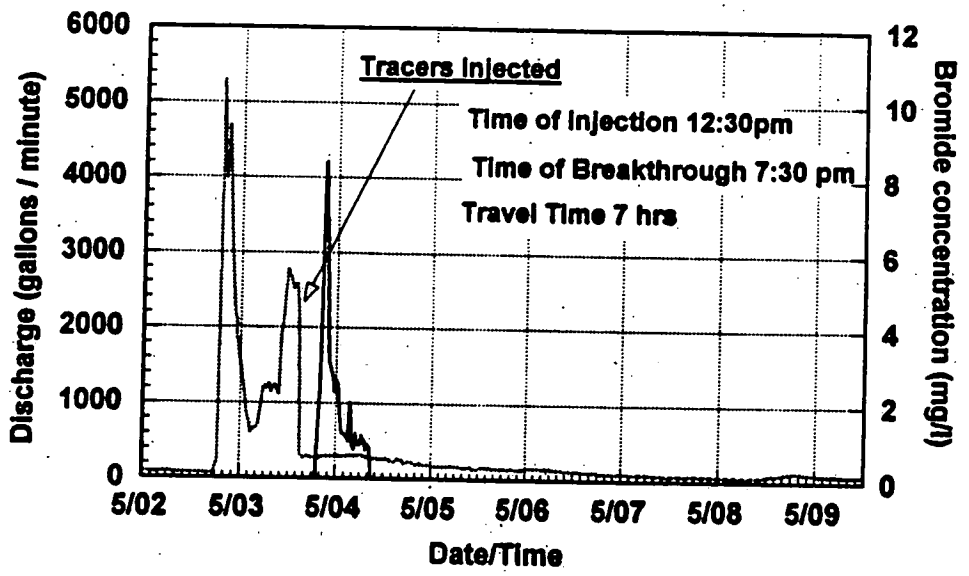


Figure 3.5. Breakthrough curves for Spring A'.

WT tracer was detected in grab samples for 4 days. The early arrival and short lived Br^- tracer pulse, compared to Rhodamine, illustrates the more conservative nature of the ionic tracer.

An approximate hydraulic conductivity can be calculated from the breakthrough curve data. Br- will be used for these calculations since it appears to have been a more conservative tracer than Rhodamine WT. It is approximately 2000 m from the injection well, 03-C02P2, to the Spring A complex, therefore the hydraulic conductivity is calculated to be 286 m hr^{-1}.

The major objective of the quantitative tracer experiment was to determine how much of the tracers could be recovered from the springs located on NSWC property. To calculate the recovery of tracer, the following equation is used:

$$M = \int_0^\infty QCdt$$

where M = mass of tracer recovered, Q= discharge, and C = tracer concentration at time *t*.

These calculations have been made and it is found that 13.9 kilograms of injected Br- (18 kilograms) was recovered, or 77% (Appendix 3.1). During the high flow conditions of the tracer test, some tracers were issuing from seeps between Spring A and Spring A', therefore some tracer

that discharged from the Spring A complex is not be accounted for in the previous calculations. It is estimated that the recovery of tracer at the Spring A complex can therefore be increased by an additional 10-15% to account for tracer issuing from the seeps. Therefore, approximately 90-95% of the Br- was recovered.

The calculation of Rhodamine WT recovery is slightly more complicated than Br^-. Rhodamine WT (20%) solution as purchased from the distributor is not actually a 20% solution. The stock powder that the 20% solution is made from (at the distributor) only has an average of 86% active ingredient (ie. Rhodamine WT). Therefore when this powder is dissolved in a liter of distilled water produces a concentration of 860,000,000 ppb. When the supplier then dilutes this to a 20% solution, the concentration is then 172,000,000 ppb. The quantity of dye that was injected was 1.6 kilograms of the solution containing 172,000,000 ppb. This is only an approximate concentration since, as confirmed by discussions with the distributor of the dye, there is an acceptable range of error of about 10% on the 20% solution (ie. the 20% solution is actually 172,000,000 ppb ± 1,720,000 ppb). Additionally, given the difficulty in weighing 1.6 kilograms of the dye solution without contaminating the dye or the lab, I estimate this measurement is accurate by 10% (ie. 1.6 kilogram ± 0.16 kilograms). This process illustrates why researchers do not routinely have great success in accurately determining the recovery of organic dyes in tracer tests.

Using this information and the equation above, it is found that 3.1×10^8 ppb of Rhodamine WT of the approximately 2.75×10^8 ppb that was injected. This means that approximately 110% of the injected Rhodamine WT was recovered. Clearly, this cannot happen and is probably a result of inaccurate measurements of either making the Rhodamine WT or in weighing out the dye.

Conclusions

A quantitative tracer test of the karst system connected to well 03-C02P2 at the ABG was conducted. 1.6 kilograms of Rhodamine WT (20%) and 18.3 kilograms of Br^- ionic tracer were injected into the well. 14 potential discharge points (springs) in the study area were monitored with passive dye receptors. 4 springs that were believed to be most likely to be hydrologically connected to injection well were continuous monitored for discharge and sampled.

Rhodamine and Br^- were detected at only one spring, consisting of a complex of 2 major orifices (Spring A and Spring A') and several diffuse seeps approximately 2000 meters from the injection well. The Br^- tracer breakthrough occurred at 7 hours, one-half hour before the Rhodamine dye. The Br^- pulse dissipated approximately 14 hours after being detected while Rhodamine dye was still detected days later. Approximately 80% of the injected Br^- was recovered at the 2 major spring orifices. 10-15% of additional Br^- is believed to have issued from the diffuse seeps. Thus approximately 90-95% of the injected Br^- can be accounted for. Approximately 110% of the injected Rhodamine dye was recovered from the same springs. That practically all of the injected tracers were recovered from the Spring A complex indicates that the karst system that was injected into has only one outlet, which is located at the Spring A complex.

The early arrival and short lived Br^- tracer pulse, compared to Rhodamine, illustrates the more conservative nature of the ionic tracer. Only one spring complex appears to be directly linked to the karst system into which the dye was injected. Using the time of first arrival for the Br^- tracer, the effective conductivity for this system is 286 m hr^{-1}. The other springs do not appear to have hydrologic connection to this karst system.

Simultaneously, a tracer experiment was conducted in which 1.6 kg of Eoscene was injected into well 03-10. This well was also believed to be on a highly conductive, or potentially karstic, part aquifer. Eoscene was never detected from springs or wells during the test. This indicates that either 03-10 is not situated on a karst conduit or the karst system that it belongs to is not part of the system that was sampled.

Appendix 3.1

Discharge, Tracer Concentration, and Tracer Recovery Tables

Spring A

Date	Time	Discharge (gal/min)	Rhodamine WT (ppb)	Mass of Rhodamine Recovered (ppb)	Bromide (mg/l)	Mass of Br Recovered kg
05/03/97	12:00:00 AM	49237.62	1.893	0.0	nd	0.0
05/03/97	04:00:00 PM	47015.14	nd	0.0	nd	0.0
05/03/97	04:30:00 PM	47015.14	nd	0.0	nd	0.0
05/03/97	05:00:00 PM	47015.14	nd	0.0	nd	0.0
05/03/97	05:30:00 PM	47015.14	nd	0.0	nd	0.0
05/03/97	06:00:00 PM	44848.12	nd	0.0	nd	0.0
05/03/97	06:30:00 PM	47015.14	nd	0.0	nd	0.0
05/03/97	07:00:00 PM	47015.14	nd	0.0	nd	0.0
05/03/97	07:30:00 PM	44848.12	13.156	2750753.6	1.0	0.2
05/03/97	08:00:00 PM	42736.34	188.721	35838716.1	4.1	0.8
05/03/97	08:15:00 PM	47015.14	326.348	30987248.1	9.1	0.9
05/03/97	08:30:00 PM	47015.14	333.556	31671664.7	8.9	0.8
05/03/97	08:45:00 PM	44848.12	296.432	25384521.6	10.4	0.9
05/03/97	09:00:00 PM	44848.12	241.483	20679089.1	8.9	0.8
05/03/97	09:15:00 PM	44848.12	161.897	14224015.2	7.5	0.7
05/03/97	09:30:00 PM	42736.34	116.319	10219598.9	5.9	0.5
05/03/97	09:30:00 PM	42736.34	133.340	12015815.3	NA	
05/03/97	09:45:00 PM	42736.34	93.376	8414466.9	4.6	0.4
05/03/97	10:00:00 PM	42736.34	69.788	5657187.0	3.9	0.4
05/03/97	10:15:00 PM	42736.34	51.746	8389246.0	3.4	0.3
05/03/97	10:30:00 PM	42736.34	40.712	6600334.8	3.0	0.5
05/03/97	10:45:00 PM	42736.34	32.211	5085015.6	NA	
05/03/97	11:00:00 PM	42736.34	27.330	3854818.0	2.5	0.4
05/03/97	11:30:00 PM	44848.12	25.077	3244521.0	2.1	0.3
05/03/97	11:45:00 PM	42736.34	23.652	2962263.8	[illegible]	0.2
05/04/97	12:00:00 AM	42736.34	0.000	2917086.4	1.5	0.2
05/04/97	12:30:00 AM	42736.34	26.897	3171354.4	1.4	0.2
05/04/97	01:00:00 AM	42736.34	27.456	3237196.9	1.4	0.2
05/04/97	01:30:00 AM	42736.34	24.743	2917380.4	[illegible]	0.2
05/04/97	02:00:00 AM	42736.34	21.161	2494985.3	1.3	0.2
05/04/97	02:30:00 AM	42736.34	18.300	2092132.6	1.2	0.1
05/04/97	03:00:00 AM	42736.34	15.678	1792405.2	1.3	0.2
05/04/97	03:30:00 AM	44848.12	13.928	1592347.1	1.1	0.1
05/04/97	04:00:00 AM	42736.34	12.249	1357250.0	1.2	0.1
05/04/97	04:30:00 AM	44848.12	10.334	1105785.3	1.2	0.1
05/04/97	05:00:00 AM	114325.2	7.495	830464.6	1.2	0.1
05/04/97	05:30:00 AM	852106.5	7.711	854390.5	1.2	0.1
05/04/97	06:00:00 AM	738565.2	7.710	881435.2	1.2	0.1
05/04/97	06:30:00 AM	779110.6	7.129	815052.1	1.9	0.2
05/04/97	07:00:00 AM	885090.1	6.382	729591.3	0.8	0.1
05/04/97	07:30:00 AM	809522.4	5.588	638832.2	1.8	0.2
05/04/97	08:00:00 AM	660979.8	4.961	584977.9	[illegible]	0.2
05/04/97	08:30:00 AM	579451.7	4.420	521194.4	1.7	0.2
05/04/97	09:00:00 AM	519678.7	5.454	662854.9	[illegible]	0.2
05/04/97	10:00:00 AM	487209.9	5.001	626383.6	[illegible]	0.1
05/04/97	10:30:00 AM	471782.2	4.568	538647.5	0.7	0.1
05/04/97	11:00:00 AM	448399.2	4.131	487119.3	nd	0.0
05/04/97	11:30:00 AM	419175.9	3.746	469219.6	nd	0.0
05/05/97	01:00:00 PM	397259.2	2.355	277625.4	nd	0.0
		Total		256824233.9		11.3

Spring A'

Date	Time	Discharge (gal/min)	Rhodamine WT (ppb)	Mass of Rhodamine Recovered (ppb)	Bromide (mg/L)	Mass of Br Recovered kg
05/03/97	12:00 AM	1515.3214	nd	0.0	nd	0.0
05/03/97	12:30 AM	1323.3527	nd	0.0	nd	0.0
05/03/97	01:00 AM	1147.2094	nd	0.0	nd	0.0
05/03/97	01:30 AM	858.27047	nd	0.0	nd	0.0
05/03/97	02:00 AM	784.53283	nd	0.0	nd	0.0
05/03/97	02:30 AM	609.66866	nd	0.0	nd	0.0
05/03/97	03:00 AM	642.44421	nd	0.0	nd	0.0
05/03/97	03:30 AM	675.96279	nd	0.0	nd	0.0
05/03/97	04:00 AM	675.96279	nd	0.0	nd	0.0
05/03/97	04:30 AM	745.2065	nd	0.0	nd	0.0
05/03/97	05:00 AM	934.8661	nd	0.0	nd	0.0
05/03/97	05:30 AM	1190.208	nd	0.0	nd	0.0
05/03/97	06:00 AM	1233.8992	nd	0.0	nd	0.0
05/03/97	06:30 AM	1190.208	nd	0.0	nd	0.0
05/03/97	07:00 AM	1278.2813	nd	0.0	nd	0.0
05/03/97	07:30 AM	1147.2094	nd	0.0	nd	0.0
05/03/97	08:00 AM	1233.8992	nd	0.0	nd	0.0
05/03/97	08:30 AM	1233.8992	nd	0.0	nd	0.0
05/03/97	09:00 AM	1190.208	nd	0.0	nd	0.0
05/03/97	09:30 AM	1100.7135	nd	0.0	nd	0.0
05/03/97	10:00 AM	1880.1802	nd	0.0	nd	0.0
05/03/97	10:30 AM	2103.6605	nd	0.0	nd	0.0
05/03/97	11:00 AM	2457.1963	nd	0.0	nd	0.0
05/03/97	11:30 AM	2772.0832	nd	0.0	nd	0.0
05/03/97	12:00 PM	2708.9541	nd	0.0	nd	0.0
05/03/97	12:30 PM	2640.2935	nd	0.0	nd	0.0
05/03/97	01:00 PM	2517.5526	nd	0.0	nd	0.0
05/03/97	01:30 PM	2578.585	nd	0.0	nd	0.0
05/03/97	02:00 PM	2578.585	nd	0.0	nd	0.0
05/03/97	02:30 PM	2103.6605	nd	0.0	nd	0.0
05/03/97	03:00 PM	317.23052	nd	0.0	nd	0.0
05/03/97	03:30 PM	317.23052	nd	0.0	nd	0.0
05/03/97	04:00 PM	270.62806	nd	0.0	nd	0.0
05/03/97	04:30 PM	293.48441	nd	0.0	nd	0.0
05/03/97	05:00 PM	317.23052	nd	0.0	nd	0.0
05/03/97	05:30 PM	293.48441	nd	0.0	nd	0.0
05/03/97	06:00 PM	270.62806	nd	0.0	nd	0.0
05/03/97	06:30 PM	270.62806	nd	0.0	nd	0.0
05/03/97	07:00 PM	270.62806	nd	0.0	nd	0.0
05/03/97	07:30 PM	270.62806	nd	0.0	1.4	0.0
05/03/97	08:00 PM	293.48441	80	2458385.3	2.6	0.1
05/03/97	08:30 PM	293.48441	250	8331288.7	6.6	0.2
05/03/97	08:45 PM		270	4498895.9	8.4	0.1
05/03/97	09:00 PM	293.48441	230	3832392.8	8.4	0.1
05/03/97	09:15 PM		180	5998527.8	6.7	0.2
05/03/97	09:30 PM	293.48441	160	5332024.8	6.9	0.2
05/03/97	09:45 PM		100	3332515.5	5.0	0.2
05/03/97	10:00 PM	293.48441	70	2332760.8	4.0	0.1
05/03/97	10:15 PM		45	1499632.0	3.1	0.1
05/03/97	10:30 PM	293.48441	35	1166380.4	3.0	0.1
05/03/97	11:00 PM	293.48441	29	966429.5	2.8	0.1
05/03/97	11:30 PM	293.48441	25	833128.9	2.7	0.1
05/04/97	12:00 AM	293.48441	20	666503.1	2.3	0.1
05/04/97	12:30 AM	317.23052	17	566527.6	2.6	0.1
05/04/97	01:00 AM	293.48441	15	499877.3	2.5	0.1
05/04/97	01:30 AM	293.48441	16	576344.4	1.7	0.1
05/04/97	02:00 AM	293.48441	18	599852.8	1.2	0.0
05/04/97	02:30 AM	293.48441	20	666503.1	1.2	0.0
05/04/97	03:00 AM	317.23052	18	599852.8	1.1	0.0

Spring A'

05/04/97	03:30 AM	317.23052	16	533202.5	1.0	0.0
05/04/97	04:00 AM	293.48441	12	432258.3	2.0	0.1
05/04/97	04:30 AM	317.23052	10	360215.3	0.9	0.0
05/04/97	05:00 AM	293.48441	8	266601.2	0.8	0.0
05/04/97	05:30 AM	317.23052	7	252150.7	1.1	0.0
05/04/97	06:00 AM	317.23052	6	199950.9	0.9	0.0
05/04/97	06:30 AM	317.23052	6	216129.2	0.9	0.0
05/04/97	07:00 AM	293.48441	6	216129.2	1.1	0.0
05/04/97	07:30 AM	293.48441	6	216129.2	1.0	0.0
05/04/97	08:00 AM	270.62806	5.5	183288.4	0.8	0.0
05/04/97	08:30 AM	270.62806	4.5	149963.2	0.9	0.0
05/04/97	09:00 AM	293.48441	4.5	138284.2	0.8	0.0
05/04/97	09:30 AM	270.62806	3.7	113700.3	nd	0.0
05/04/97	10:00 AM	270.62806	3.6	119970.6	nd	0.0
05/04/97	10:30 AM	270.62806	3	92189.4	nd	0.0
05/04/97	11:00 AM	248.6862	3	92189.4	nd	0.0
05/04/97	11:30 AM	270.62806	2.5	76824.5	nd	0.0
05/04/97	12:00 PM	248.6862	2.5	70595.8	nd	0.0
05/04/97	12:30 PM	270.62806	2.3	70678.6	nd	0.0
05/04/97	01:00 PM	248.6862	2.2	62124.3	nd	0.0
05/04/97	01:30 PM	248.6862	2.1	64532.6	nd	0.0
05/04/97	02:00 PM	227.68784	2	56476.6	nd	0.0
05/04/97	02:30 PM	227.68784	2.2	62124.3	nd	0.0
05/04/97	03:00 PM	248.6862	1.8	46537.1	nd	0.0
05/04/97	03:30 PM	270.62806	1.75	45244.4	nd	0.0
05/04/97	04:00 PM	248.6862	1.7	48005.1	nd	0.0
05/04/97	04:30 PM	248.6862	1.65	50704.2	nd	0.0
05/04/97	05:00 PM	205.72075	1.5	42357.5	nd	0.0
05/04/97	05:30 PM	227.68784	1.4	39533.6	nd	0.0
05/04/97	06:00 PM	227.68784	1.3	30367.5	nd	0.0
05/04/97	06:30 PM	227.68784	1.2	31024.7	nd	0.0
05/04/97	07:00 PM	227.68784	1.65	42659.0	nd	0.0
05/04/97	07:30 PM	205.72075	1.5	38780.9	nd	0.0
05/04/97	08:00 PM	186.82479	1.42	36712.6	nd	0.0
05/04/97	08:30 PM	205.72075	0.85	19855.7	nd	0.0
05/04/97	09:00 PM	205.72075	0.9	19092.6	nd	0.0
05/04/97	09:30 PM	186.82479	0.83	19388.5	nd	0.0
05/04/97	10:00 PM	186.82479	0.92	21490.8	nd	0.0
05/04/97	10:30 PM	186.82479	0.99	21001.8	nd	0.0
05/04/97	11:00 PM	186.82479	0.9	19092.6	nd	0.0
05/04/97	11:00 PM	186.82479	0.83	17607.6	nd	0.0
05/05/97	12:00 AM	186.82479	0.8	16971.2	nd	0.0
05/05/97	12:30 AM	186.82479	0.8	16971.2	nd	0.0
05/05/97	01:00 AM	169.00635	nd	0.0	nd	0.0
		Total		49426930.5		2.6

CHAPTER 4. QUANTIFYING THE HYDROLOGIC CONNECTION BETWEEN THE POROUS MEDIA AND KARSTIC FLOW REGIMES OF THE BEECH CREEK AQUIFER AT THE AMMUNITION BURNING GROUNDS, NAVAL SURFACE WARFARE CENTER, CRANE, INDIANA

Abstract

In well developed karst terrains, three distinct portions of the continuum can be identified on hydrographs of springs issuing from the karst aquifer. Hydrographs from two karst springs, Springs A and C, at the Crane Naval Surface Warfare Center, Indiana, have been analyzed and values of transmissivity (T) / Storativity (*Sy*) established for the conduit-, diffuse-, and mixed-flow systems. Using data collected from pumping test and dye traces in the area allows independent values of T and Sy to be established for the conduit and diffuse-flow systems. Only ratios of T/Sy can be established for the mixed-flow system. Values of T and Sy for the conduit and diffuse systems are consistent with values obtained from independent dye traces and pumping tests.

Results suggest that values of T for the conduit system of these springs may need to be established at a local scale, while the values for the diffuse-flow system may be applicable at a regional scale. Additionally, hydraulic parameters for the mixed-flow system should be established at a local scale.

Introduction

Groundwater studies in karst terrains have recently become a subject of intense study due, in part, to the high risk of migration of contaminated groundwater in these areas. Studying these systems is inherently difficult due to the dichotomy of flow characteristics of the rock matrix and conduit systems. For example, porosity in the rock matrix of a carbonate aquifers is generally considered to be negligible (e.g. ~0.0). However, where the aquifer material is fractured or has

solutionally enlarged voids, values of secondary and tertiary porosity can be quite large. As a result, karst aquifers show temporal and spatial variation between rock matrix and conduit dominated flow regimes. This variable nature of hydraulic properties in karst aquifers makes it difficult to quantify the movement of groundwater through and/or between different parts of the aquifer.

The identification of meaningful hydraulic parameters in karst aquifers is further complicated by incorrect techniques for data collection and/or interpretation. Field methods such as pump tests, injection tests, packer tests, and slug tests, used to determine hydraulic properties for diffuse-flow systems may not provide estimates for the conduit system. Even in the rare case where a conduit is either penetrated by, or is next to, a well being tested, the spatial variation in conduit aperture size and lack of interconnectedness of most conduits limits the applicability of test results to the area immediately around the well. As a result, hydraulic parameters derived from methods relying on well data typically do not provide accurate measurements of conduit properties.

In contrast to groundwater moving toward wells, karst springs show the response of the entire karst system to aerial recharge events (Lakey and Krothe, 1996; Teutsch and Sauter, 1991; Sauter, 1991). In well developed karst terrains, hydrographs from karst springs show rapid responses to rain events followed by two distinct portions of a long recession limb (Figure 4.1). In these areas, hydrograph recession curves can be used to calculate hydraulic parameters for the conduit, diffuse, and mixed-flow parts of the karst system, or continuum (Milanovic, 1981; Sauter, 1991).

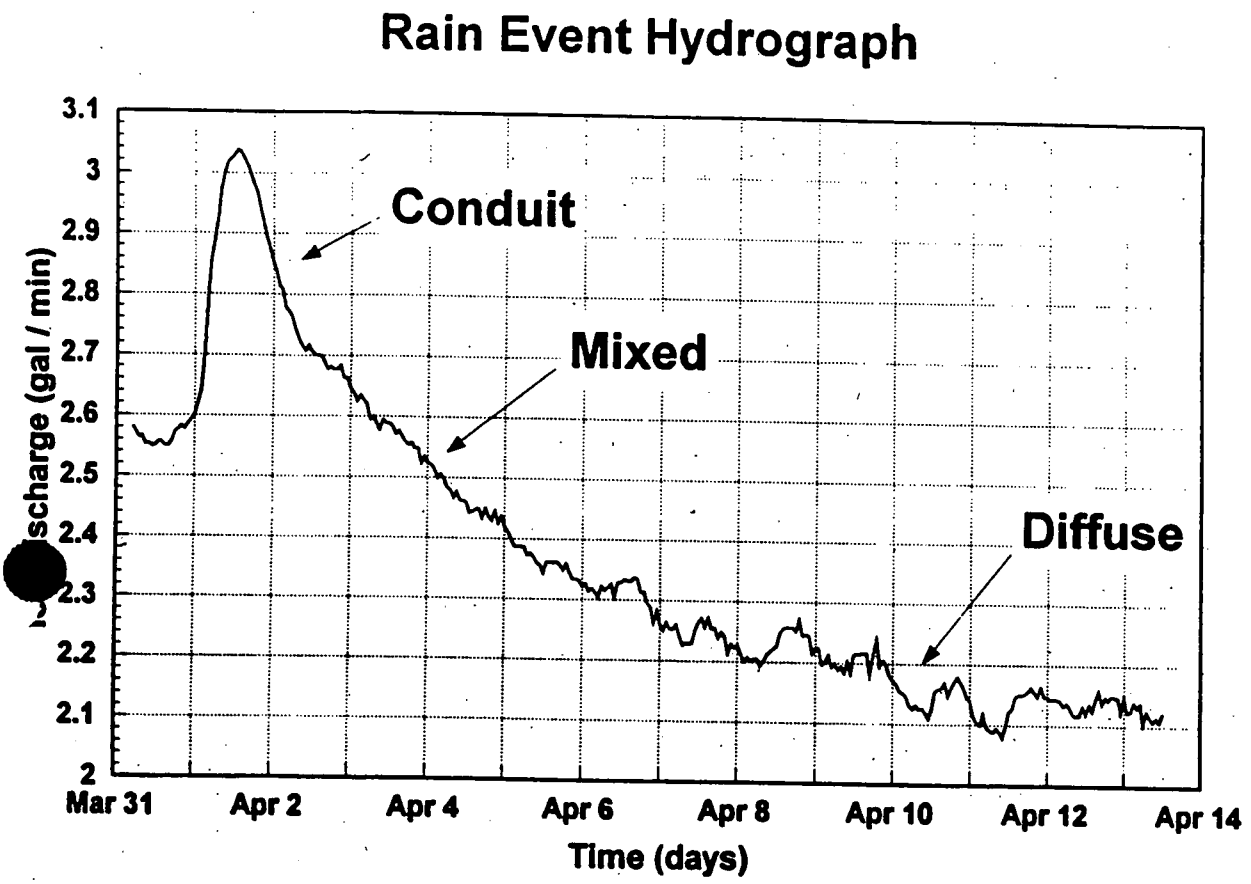


Figure 4.1. Typical recession hydrograph from springs in the study area. Hydrograph shows 3 segments related the conduit, diffuse, and mixed-flow parts of the karst system

Methodology

The basis for quantifying hydraulic parameters from recession hydrographs comes from the general equation:

$$Q_t = Q_0 \cdot e^{\alpha(t-t_0)} \qquad \text{Eq. 1}$$

which describes concentrated discharge of an aquifer (Milanovic, 1988). In this equation α relates to the ability of the aquifer to release water, Q_t = discharge during the observation period t - t_0, and Q_0 = spring discharge at time t_0.

For baseflow recession in a parallel-sided aquifer Rorabaugh (1964) showed:

$$Q = 2T\left(\frac{h_0}{L}\right)e^{\pi^2 Tt/4L^2 S} \qquad \text{Eq. 2}$$

where T= transmissivity, S = storativity, L = distance from the discharge point to the drainage divide, and t = time of observation. Atkinson (1977) rearranged this equation and estimated hydraulic parameters of an unconfined aquifer from baseflow recession curves:

$$\log\left(\frac{Q_1}{Q_2}\right) = \frac{T}{S_y}\cdot(t_2 - t_1)\cdot\frac{1071}{L^2} \qquad \text{Eq. 3}$$

where Sy = specific storage. In order to establish a value for the variable L in a karst terrain, where the boundaries of the drainage divide can change spatially and temporally under different aquifer conditions, detailed tracing experiments are required. This information typically does not exist for most karst aquifers, so it is common practice to assign each discharge location a value of

L that measured from the discharge point to the topographically defined drainage divide (Shevenell, 1996; Teutsch and Sauter, 1991; Atkinson, 1977).

Equation 3 can be rearranged so that the ratio of transmissivity to specific yield (T / Sy) for each segment of the recession curve can be calculated once a value of L has been established and the slope of each segment of the recession curve is known,

$$\frac{T}{S_y} = \frac{\log\left(\frac{Q_1}{Q_2}\right)}{(t_2 - t_1)} \cdot \frac{L^2}{1.071} \qquad \text{Eq. 4}$$

This method has been used to determine hydraulic parameters for the conduit, diffuse, and mixed-flow systems of a karstic aquifer in south-central Indiana. Where possible, these hydraulic parameters derived from this method are complimented with and compared to results obtained from pump tests of the diffuse-flow system and dye traces of the conduit system.

Hydrogeology Properties of the Study Area

The geology of the NSWC consists of the Pennsylvanian age Mansfield Formation and the Mississippian age Golcanda/Haney limestone, Indian Springs Shale, Big Clifty Sandstone, Beech Creek Limestone, and the Elwren Shale. Together, the Big Clifty Sandstone and the Beech Creek Limestone comprise the Beech Creek aquifer. The Beech Creek is typically a dense, karstified limestone approximately 6.1 m (20 ft) thick. Locally, drillers have encounter voids and solution

cavities in the unit (Hunt, 1988 and Murphy and Ciocco, 1990), confirming the karstic nature of this unit. It is apparent to site managers at the NSWC that predictive models of the fate and transport of groundwater contaminants at the ABG, need to account for the differences in hydraulic parameters of the diffuse-flow and conduit systems.

The hydrology of the study area is predominately controlled by the karstic nature of the Beech Creek aquifer. Rain and surface water percolates into the Big Clifty sandstone and moves vertically and laterally by diffuse-flow. As a result of local jointing, groundwater in this unit also moves vertically by fracture-flow (conduit-flow), which recharges the underlying Beech Creek limestone. The Elwren Shale, at the base of the Beech Creek Limestone, restricts further vertical movement of groundwater, however, lateral movement continues via diffuse and conduit flow.

Pump tests have been perfomed on wells screened in the Beech Creek aquifer. Analysis of this data using the a Jacob method (Jacob, 1950) suggest that the unfractured portion of the Beech Creek aquifer has transmissivities (T) that range from 0.28 $m^2 day^{-1}$ to 5.79 $m^2 day^{-1}$ and storativities (Sy) that range from $4x10^{-4}$ to $2.5x10^{-5}$ (Murphy, 1995) (Figures 4.2, 4.3, and 4.4). The average thickness of the Beech Creek aquifer is 6.1 m, so the hydraulic conductivity (K) of this unit is approximately $5x10^{-2}$ m day^{-1} to 0.9 m day^{-1}. These values are near the upper bound of the typical range of K for unfractured limestones ($9x10^{-5}$ m day^{-1} to 0.1 m day^{-1}) as reported by Freeze and Cherry (1979).

Dye traces in the Beech Creek aquifer suggest that several springs, designated A, A', and C, are the primary outlets for karstic groundwater in the study area (Murphy and Ciocco, 1990; Krothe and Baedke, in prep). Results from these studies suggest that hydraulic conductivity of the

Spring A conduit-flow system range from 3700 to 7400 m day^{-1}, depending on aquifer recharge. Considering these results and those from pump test, it is appears that groundwater movement is predominately through karst related conduits.

Springs A, A' and C are perennial and show large increases in discharges with rapid recessions after rainfall. These springs are in hydrologic connection with both the conduit- and diffuse-flow systems. Krothe et al. (1996) used isotopes of deuterium and oxygen to show that discharge at Spring A, following a rain event, can be explained in terms of a two-component mixing model. One end member of the model is rainwater moving through the aquifer via conduits while the other end member is groundwater that is released from pores of the rock matrix and discharged into the conduit. All points between the two end members can be explained by mixing of the two end members (Figure 4.5). The results of this isotopic study confirms that discharge at Spring A can be broken into three sources: 1) discharge from predominantly conduit sources (conduit-flow system); 2) discharge predominantly from the rock matrix (diffuse-flow system); and 3) discharge resulting from a mixture of the conduit and diffuse-flow system (mixed-flow system). Hydrograph analysis' of Spring A following a rain event should confirm that the presence of these three flow systems.

Hydrograph Analysis Determination of Hydraulic Parameters

Springs C and A, south of the ABG were continuously monitored for flow for a two month period (Fig. 4.6). During this period, six rain events caused a significant discharge response in each spring. Discharge at each spring was calculated and recorded with weirs and continuous recording pressure transducers that were calibrated within a range of discharges with a rating curve.

Results

Three components of flow are easily identified for each spring since each component has a distinctly different slope on the discharge hydrographs (Fig. 4.1). The steeply sloped segment of the recession hydrograph immediately following peak discharge represents flow that is predominately through conduits. The large volume of water in the conduits is quickly discharged at the spring and dominance of the hydrograph by the conduit system ceases. This portion of the hydrograph is followed by a less steeply inclined segment, representing water moving through the conduits and the arrival of a pulse of rain derived groundwater moving through the rock matrix. As the rainwater moving in the conduits and the pulse of rain derived groundwater gradually dissipates spring discharge becomes dominated by groundwater released from the pores of the rock matrix. This last component of flow is seen on the recession hydrograph as the most shallow inclined line segment.

Using equation 4, T/S*y* ratios have been calculated for all line segments that can be clearly identified. These values are shown on the discharge hydrographs in Figure 4 and are reported in Table 4.1. Using these ratios, along with the results of previous physical testing of the aquifer, it is possible to identify effective hydraulic parameters for the three flow components identified on the hydrograph. In all calculations, we have assumed an "average" value of *L* for Spring A to be 220 m and 840 m for Spring C.

Hydraulic Parameters of the Conduit Flow System

Using equation 4, the T/Sy ratio for this portion of the hydrograph from Spring A ranges from 15,000 - 20,500 m^2day^{-1}, with an average of 17,700 m^2day^{-1} (Note: The last two rain events

caused discharges at Spring A to exceed the calibrated range of the weir and pressure transducers and are not included in this discussion). The Spring C hydrograph analysis results in T/Sy ratios of 287,000 to 384,000 m^2day^{-1}, with an average of 364,000 m^2day^{-1}.

By definition, the conduit system has a S*y* value of 1.0, therefore the transmissivity of the conduit system feeding each spring is identical to the respective T/Sy ratios (Table 1). Knowing that the BC-BC aquifer averages 6.1 m in thickness, average hydraulic conductivities (K) can be calculated for the conduit systems at each spring. The average K for Spring A is 2,900 $mday^{-1}$, while the average K for Spring C is 64,000 $mday^{-1}$.

The values of conduit K for the two springs are dramatically different, suggesting that the two springs are not on the same conduit network. This is in agreement with the previously discussed dye traces in the area that also demonstrated that Springs A and C do not share the same conduit system. The K values established for the conduit system of Spring A from the hydrograph method are in general agreement with the values established from the previously discussed dye traces. Additionally, the values of T and K are very different for the two conduit systems in this study, suggesting that hydraulic parameters of the conduit system need to be established at a local scale.

Hydraulic Parameters of the Mixed Flow System

Using equation 4 to calculate the T/S*y* ratio for the mixed flow system gives values for Spring A that range from 4,500 - 6,000 m^2day^{-1} with an average of 5,200 $m2day^{-1}$. For Spring C the T/Sy values are 108,000 - 158,000 m^2day^{-1}. The values of T/Sy for the two springs are again

very different, suggesting that hydraulic properties for the mixed flow system be established at a local scale.

Hydraulic Parameters of the Diffuse System (Rock Matrix)

During the time of this study, the diffuse flow system dominated the hydrographs during only two periods. Hydrograph analysis for Spring A suggests that the T/Sy ratios for these two periods are 1,200 and 1,300 m^2day^{-1}. For Spring C, the values are 18,400 and 28,000 m^2day^{-1}.

The previously discussed pump tests provide estimates of the transmissivity of the diffuse system to be approximately 1.0 m^2day^{-1}. Assuming this average T for the diffuse system, values of Sy can be calculated from the hydrograph derived ratios of T/Sy. Performing these calculations leads to an average S*y* for Springs A and C as $8x10^{-4}$ and $6.5x10^{-5}$, respectively.

These values are similar in magnitude and range to the values of Sy determined by pump tests ($4x10^{-4}$ to $2.5x10^{-5}$). This suggests that the hydrograph analysis may be an effective tool for determining hydraulic properties of the diffuse-flow system in a karst terrain. Since the results of pump tests are typically applied to regional or sub-regional scaled portions of aquifer, it may also be possible to apply the values obtained from the hydrograph analysis to regional or sub-regional portions of the diffuse system in karst aquifers.

Conclusions

Hydraulic parameters in karst terrains are typically described in terms of a continuum whose end-members are the conduits and the rock matrix. However, in well developed karst

terrains, hydraulic parameters from three distinguishable flow systems of the aquifer predominate. These are the conduit-, mixed-, and diffuse-flow systems.

Two karst springs, Springs A and C, in the at the Crane Naval Surface Warfare Center, Indiana, have been continuously monitored for discharge. Rain event recession hydrographs show distinct segments that representing flow derived from: 1) conduits, 2) rock matrix, and 3) a mixture of the two. The slope of each segment of the recession curve, and a distance term that represents the distance the spring is to its source of recharge, can be used to calculate ratio of T/S*y* for that part of the continuum.

Assuming a S*y* of 1.0 for the conduit system permits T of the conduit system to be calculated. For Spring A an average value of at 17,600 m^2day^{-1} results. This value is comparable to values obtained by dye traces of the Spring A conduit network. For Spring C, the average value of T is 364,000 m^2day^{-1}. These values are considerable different, and since conduit systems typically display considerable spatial variability, T values for this part of the continuum need to be established at a local scale.

Only ratios of T / S*y* can be calculated for the mixed-flow segments of the hydrographs. The average T/Sy value for Springs A and C are 5,200 and 122,000 m^2day^{-1} respectively. Again the variability between the two averages suggests that hydraulic parameters for this part of the flow system should be established at a local scale.

Pumping tests from the unfractured part of the aquifer show values of T for the rock matrix to be 0.3 to 5.8 m^2day^{-1} and S*y* to be 3.6E-4 to 5.4E-5. Assuming an average value of 1.5

for T, S*y*'s from analysis of the hydrographs can be calculated. The results show that the Sy for the two springs are in general agreement with each other and that the value is for this part of the continuum is 8E-4 to 4E-5. The close agreement of S*y* values suggests that hydraulic properties of the rock matrix may be applicable at a regional scale.

Table 4.1.

Aquifer Portion (Means Defined)	T / Sy (m^2 / day)	T (m^2 / day)	Sy
Conduit			
Hydrograph Analysis Spring A	17,600	17,600	1.0*
Hydrograph Analysis Spring C	364,000	364,000	1.0*
Dye Trace	NA	74000 - 148000	NA
Diffuse			
Hydrograph Analysis Spring A	1,250	1.0*	8E-4
Hydrograph Analysis Spring C	23,000	1.0*	4E-5
Pumping Tests	NA	0.28 - 5.79	3.6E-4 - 5.4E-5
Mixed			
Hydrograph Analysis Spring A	5,200	Unknown	Unknown
Hydrograph Analysis Spring C	122,000	Unknown	Unknown

NA = Not Applicable
* = Assumed Value

Table 4.1. Summary of values for hydraulic parameters calculated from this study and from other methods.

Figure and Table Captions

Figure 4.1: Typical rain event hydrograph from a spring in the study area. Three distinct segments of the hydrograph are labeled. 1) Discharge related the conduit-flow system (Conduit); 2) Discharge related to a combination of the conduit- and diffuse-flow system (Mixed); and 3) Discharge related the diffuse-flow system (Diffuse)

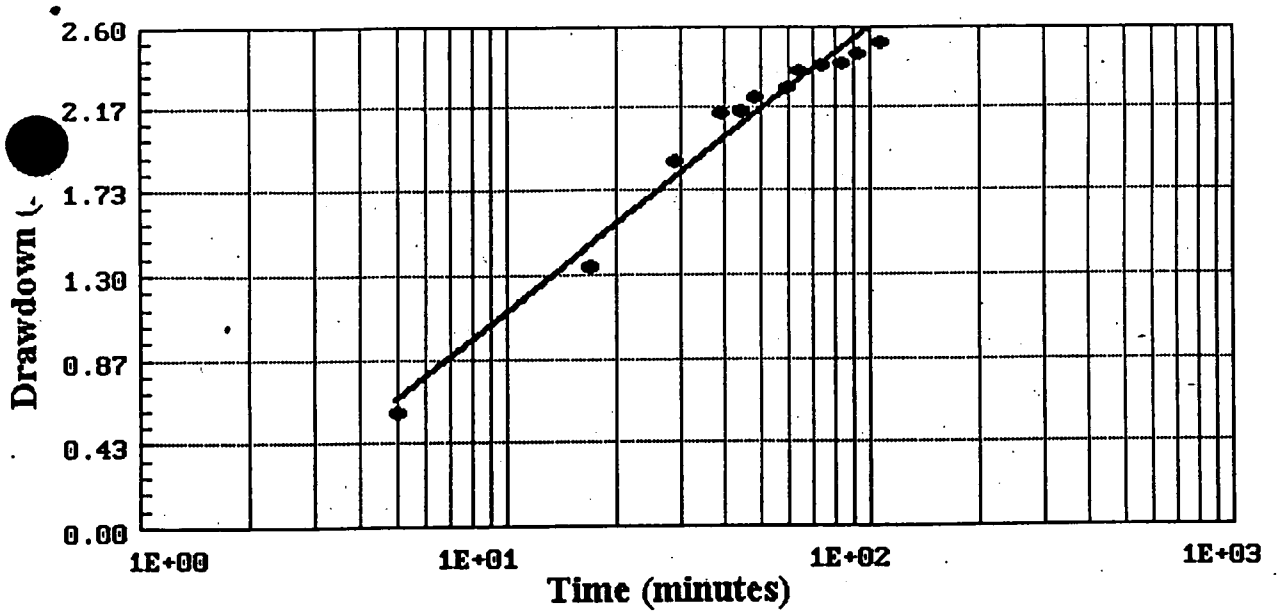
Figure 4.2: Pump test results of well 03-PMP11 as analyzed by the Jacob method.

Figure 4.3: Pump test results of well 03-PMP08 as analyzed by the Jacob method.

Figure 4.4: Pump test results of well 03-PMP20 as analyzed by the Jacob method.

Figure 4.4: Mixing trend of rain water and phreatic water seen in a comparison of hydrogen and oxygen isotopes of spring discharge following a rain event. (Noriega, 1997)

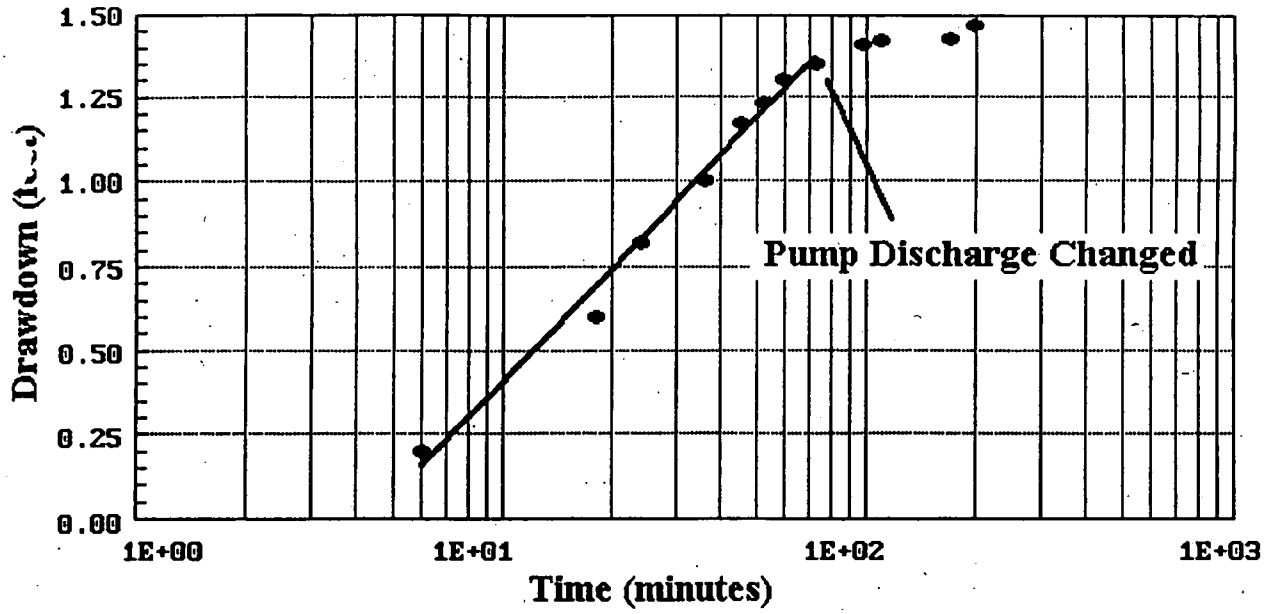
Figure 4.5. Two-month hydrographs for Springs A and C (thin lines). Heavy lines show the conduit-, mixed-, and diffuse-flow systems. Numbers correspond to the ratio of T/S*y* calculated from the corresponding segment of the hydrograph. A * next to the values of T/S*y* indicates that discharges exceeded the calibrated range of the weir and pressure transducers for the rain event.



Transmissivity = 3.45 E-5 ft2/sec (0.28 m2/day)

Storativity = 3.74 E-5

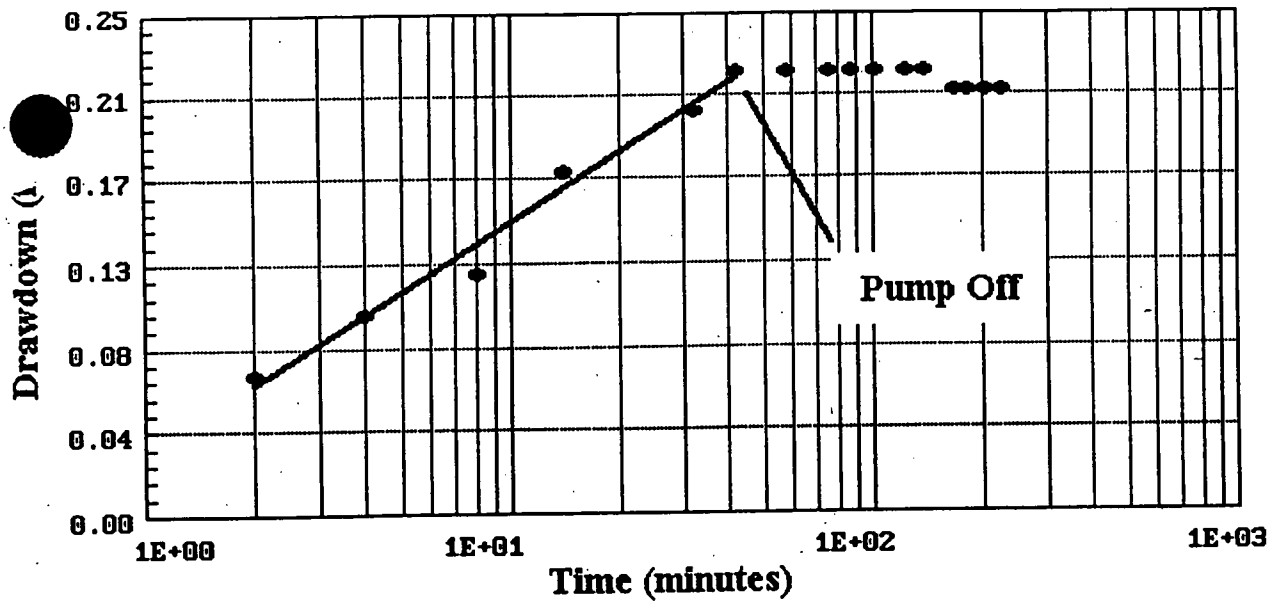
Fig. 4.2



Transmissivity = 1.61 E-4 ft2/sec (1.29 m2/day)

Storativity = 5.39 E-5

Fig. 4.3



Transmissivity = 7.22 E-4 ft2/sec (5.79 m2/day)

Storativity = 3.62 E-4

Fig 4.4

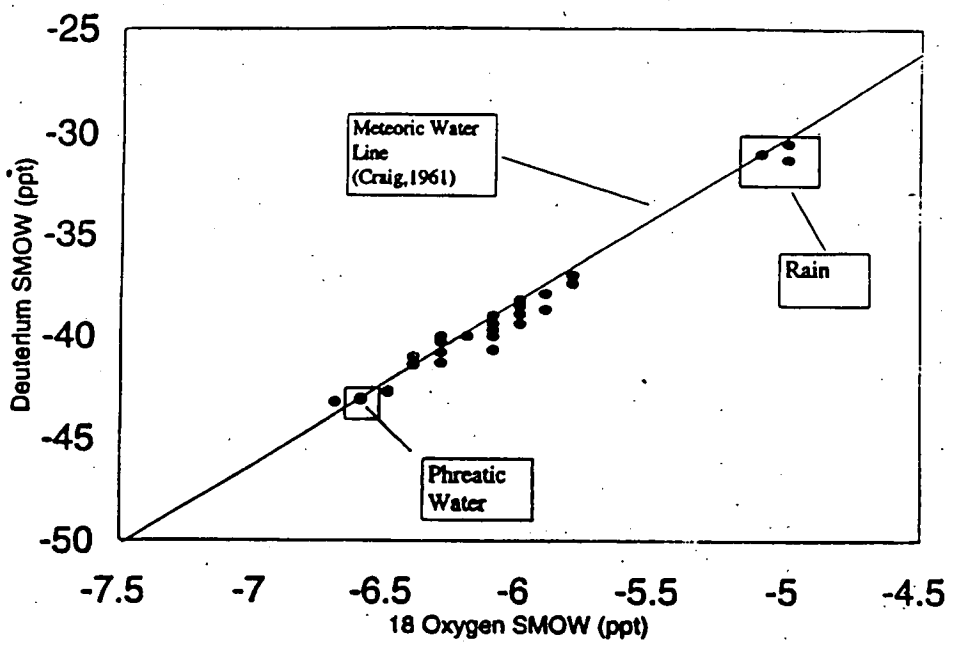

-25
-30
-35
-40
-45
-50
Deuterium SMOW (ppt)
-7.5
-7
-6.5
-6
-5.5
-5
-4.5
18 Oxygen SMOW (ppt)
Meteoric Water Line (Craig,1961)
Rain
Phreatic Water

Figure 4.

Recession Hydrographs

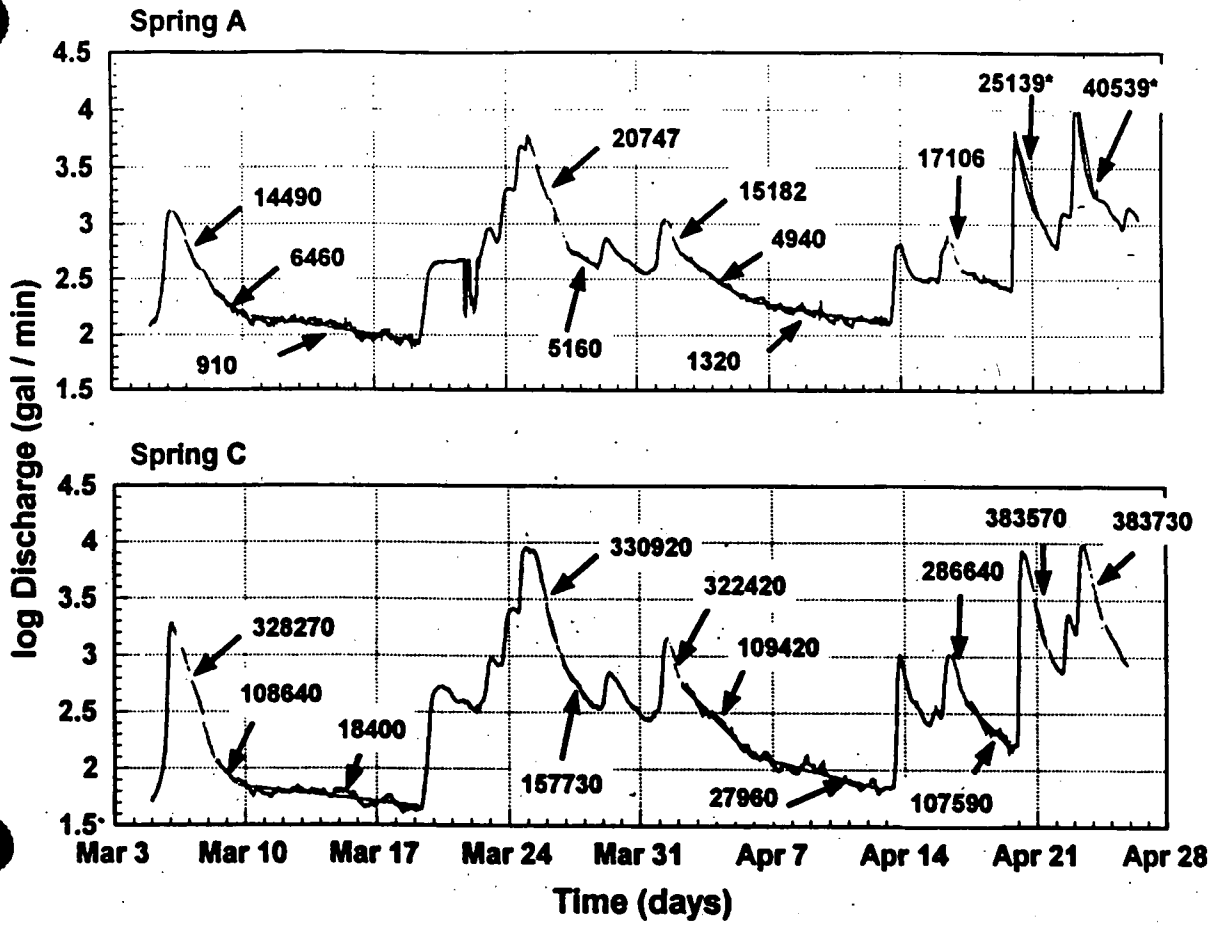


Fig. 4.5

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VITA

Name:	Steven Jay Baedke
Date of Birth:	October 18, 1965
Place of Birth:	Estherville, Iowa
Education:	B.Sc., University of Northern Iowa Cedar Falls, Iowa 1988
	M.S. Indiana University Bloomington, Indiana 1990
Academic Positions:	Associate Instructor Dept. of Geological Sciences, Indiana University Bloomington, IN 1988 - 1990, 1995-1996
	Instructor Dept. of Geology and Environmental Studies, James Madison University Harrisonburg, VA 1997
Professional Positions:	Hydrogeologist / Groundwater Modeler International Ground Water Modeling Center (IGWMC), Butler University
	Holcomb Research Institute Indianapolis, IN 1990 - 1991
	Research Scientist Indiana Geological Survey, Indiana University Bloomington, IN 1991-1995